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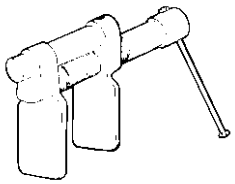
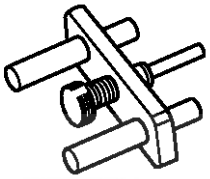
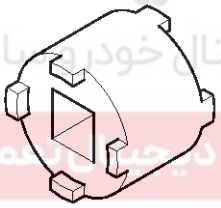
General Information

SPECIAL SERVICE TOOLS

Tool (Number and Name)	Illustration	Use
09581 - 11000 Piston expander		Pushing back of the front disc and rear disc brake piston
0K993 430 032 Adjustment gauge		Used to adjust push rod gap
09580 - 34000 Rear brake piston adjuster		Removal and installation of the rear disk brake piston

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TROUBLESHOOTING

PROBLEM SYMPTOMS TABLE

Use the table below to help you find the cause of the problem. The numbers indicate the priority of the like cause of the problem. Check each part in order. If necessary, replace these parts.

Symptom	Suspect area	Remedy
Lower pedal or spongy pedal	1. Brake system (Fluid leaks)	Repair
	2. Brake system (Air in)	Air bleeding
	3. Piston seals (Worn or damaged)	Replace
	4. Master cylinder (Faulty)	Adjust
Brake drag	1. Brake pedal free play (Minimum)	Adjust
	2. Parking brake lever travel (Out of adjustment)	Adjust
	3. Parking brake wire (Sticking)	Repair
	4. Pad or lining (Cracked or distorted)	Replace
	5. Piston (Stuck)	Replace
	6. Piston (Frozen)	Replace
	7. Return spring (Faulty)	Replace
	8. Booster system (Vacuum leaks)	Repair
	9. Master cylinder (Faulty)	Replace
Brake pull	1. Pad or lining (Oily)	Replace
	2. Piston (Frozen)	Replace
	3. Disc (Scored)	Replace
	4. Pad or lining (Cracked or distorted)	Replace
Hard pedal but brake inefficient	1. Brake system (Fluid leaks)	Repair
	2. Brake system (Air in)	Air bleeding
	3. Pad or lining (Worn)	Replace
	4. Pad or lining (Cracked or distorted)	Replace
	5. Pad or lining (Oily)	Replace
	6. Disc (Scored)	Replace
	7. Booster system (Vacuum leaks)	Repair

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Noise from brake	1. Pad or lining (Cracked or distorted)	Replace
	2. Installation bolt (Loosen)	Retighten
	3. Disc (Scored)	Replace
	4. Pad retainers (Loosen)	Retighten
	5. Sliding pin (Worn)	Replace
	6. Pad or lining (Dirty)	Clean
	7. Pad or lining (Glazed)	Replace
	8. Return spring (Faulty)	Replace
	9. Brake pad shim (Damage)	Replace
	10. Shoe hold-down spring (Damage)	Replace

Operation and Leakage Check

Check all of the following items:

Component	Procedure
Brake Booster (A)	Check brake operation by applying the brakes during a test drive. If the brakes do not work properly, check the brake booster. Replace the brake booster as an assembly if it does not work properly or if there are signs of leakage.
Piston cup and pressure cup inspection (B)	Check brake operation by applying the brakes. Look for damage or signs of fluid leakage. Replace the master cylinder as an assembly if the pedal does not work properly or if there is damage or signs of fluid leakage.
	Check for a difference in brake pedal stroke between quick and slow brake applications. the master cylinder if there is a difference in pedal stroke.
Brake hoses (C)	Look for damage or signs of fluid leakage. Replace the brake hose with a new one if it is damaged or leaking.
Caliper piston seal and piston boots (D)	Check brake operation by applying the brakes. Look for damage or signs of fluid leakage. If the pedal does not work properly, the brakes drag, or there is damage or signs of fluid leakage, disassemble and inspect the brake caliper. Replace the boots and seals with new ones whenever the brake caliper is disassembled.
Wheel cylinder piston cup and dust cover (E)	Check brake operation by applying the brakes. Look for damage or signs of fluid leakage. If the pedal does not work properly, the brakes drag, or there is damage or signs of fluid leakage, replace the wheel cylinder.

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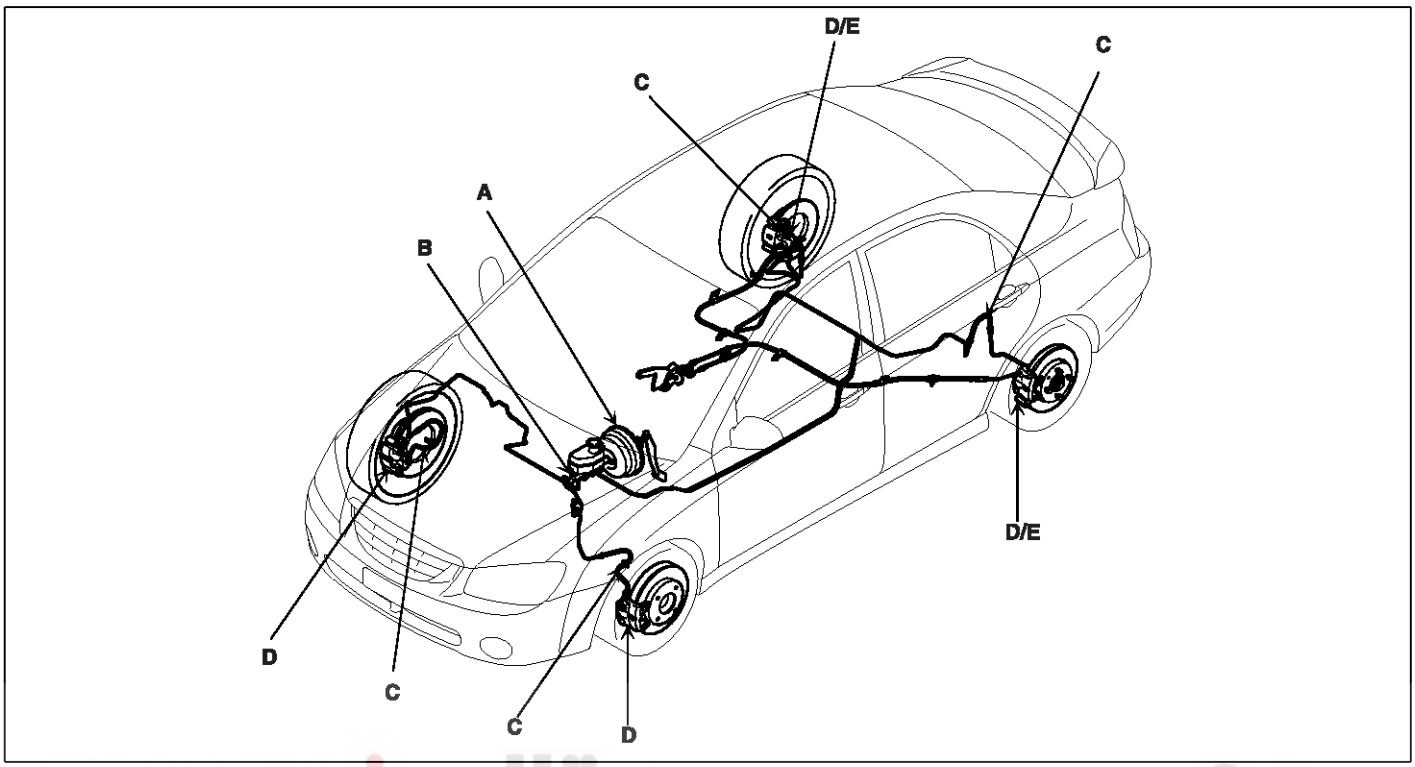

AJGE001A

SPECIFICATIONS (Brake)

Item	Specification	
Master cylinder Type I.D. Fluid level warning sensor	 Tandem type 22.2 mm(0.874 in.) : Gasoline(α-engine : CBS), 23.8 mm(0.937 in.) : Gasoline, Diesel(ABS, TCS) Provided	
Proportioning valve(CBS) Cut-in pressure(Split point) Decompression ratio	 Rear drum : 26kg/cm² (2.55MPa, 370psi) Rear disc : 40kg/cm² (3.92MPa, 568psi) 0.27 : 1	
Brake booster Type Effective diameter Boosting ratio	 Vacuum Tandem type with 7+8 in. 7.5 : 1(CBS), 7.5 : 1/11.0 : 1(ABS/TCS) - 2-ratio type	
Front brake(Disc)	Gasoline (α-engine : CBS)	Gasoline(ABS), Diesel(CBS, ABS)
Type Disc O.D. Disc thickness Pad thickness Cylinder type Cylinder I.D.	Floating type with ventilated disc 257 mm(10.11 in.) 24 mm(0.945 in.) 11 mm(0.43 in.) Single piston Ø54 mm(2.12 in.)	Floating type with ventilated disc 275 mm(10.83 in.) 26 mm(1.02 in.) 11 mm(0.43 in.) Single piston Ø57.2 mm(2.25 in.)

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Rear brake(Disc)	
Type	Floating type with solid disc
Disc O.D.	258 mm(10.16 in.)
Disc thickness	10 mm(0.39 in.)
Pad thickness	9 mm(0.35 in.)
Cylinder type	Single piston
Cylinder I.D.	Ø33.96 mm(1.34 in.)
Rear brake(Drum)	
Type	Leading trailing
Drum I.D.	203.2 mm(8 in.)
Brake lining thickness	4.5 mm(0.18 in.)
Clearance adjustment	Automatic
Parking brake	
Actuation	Mechanical brake acting on rear wheels
Type	Lever
Cable arrangement	V type

NOTICE

ABS : Anti-lock Brake System

CBS : Conventional Brake System

TCS : Traction Control System

SERVICE STANDARD

Item	Standard value
Standard value	
Brake pedal height	189 mm(7.24in.)
Brake pedal stroke	122~127 mm(4.8~5.0 in.)
Stop lamp switch outer case to pedal stopper clearance	1.0 ~ 1.5mm(0.04 ~ 0.06in.)
Brake pedal free play	3~8 mm(0.11~0.31 in.)
Booster push rod to master cylinder piston clearance	0 (at 500 mmHg vacuum)
Parking brake lever stroke when lever assembly is pulled with 196N (20Kg, 44lb force)	8~9 clicks: Rear Disc type, 8 clicks: Rear Drum type
Service limit	
Front disc brake pad thickness (minimum)	2.0 mm(0.079 in.)
Front disc thickness (minimum)	22 mm(0.866 in.) : Gasoline (α-engine:CBS), 24 mm(0.945 in.) : Gasoline(ABS), Diesel(ABS, CBS)
Front disc run out	0.03mm(0.0012 in.)
Front disc parallelism	0.005 mm(0.0002 in.)
Rear drum brake lining thickness (minimum)	1.0 mm(0.039 in.)
Rear drum brake drum I.D. (maximum)	205.2 mm(8.08 in.)
Rear disc brake pad thickness (minimum)	2.0 mm(0.079 in.)
Rear disc brake disc thickness (minimum)	8 mm(0.315 in.)
Rear disc run out	0.03mm(0.0012 in.)
Rear disc parallelism	0.005 mm(0.0002 in.)

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TIGHTENING TORQUE(Brake)

Item	Nm	kg·cm	lb·ft
Master cylinder to booster mounting nut	8-12	80-120	5.9-8.9
Brake booster mounting nut	13-16	130-160	9.6-11.8
Bleeder screw	7-9	70-90	5.2-6.6
Brake tube nut, brake hose	13-17	130-170	9.6-12.5
Caliper guide rod bolt	22-32	220-320	16.2-23.6
Member assembly bracket mounting bolt	8-12	80-120	5.9-8.9
Brake pedal mounting bolt	25-35	250-350	18.4-25.8
Stop lamp switch mounting nut	8-10	80-100	5.9-7.2
Caliper assembly to knuckle	69-85	690-850	50.9-62.6
Brake hose to front caliper	25-30	250-300	18.4-22.1
Brake hub flange nut	200-260	2000-2600	147.5-191.8
Wheel cylinder mounting bolt	5-11	50-110	3.7-8.1
Rear drum backing plate mounting bolt	50-60	500-600	36.2-43.4
Proportioning valve to master cylinder	35-55	350-550	25.8-39.8

TIGHTENING TORQUE(ABS&TCS)

Item	Standard value [Nm (kg·cm, lb·ft)]
Sensor mounting bolt • Front • Rear	 8.8-13.7 (90-140, 6.5-10.1) 8.8-13.7 (90-140, 6.5-10.1)
HECU mounting bolt	11-14 (110-140, 7-10)
HECU mounting bracket bolt	17-26 (170-260, 12-19)
Brake tube nut	13-17 (130-170, 9-12)
Bleeder screw	7-13 (70-130, 5-9)

LUBRICANT

Item	Recommended lubricant	Quantity
Brake fluid	DOT 3 or DOT 4	As required
Brake pedal bushing and brake pedal bolt	Chassis grease SAE J310, NLGI No.0	As required
Pin of brake pedal	Wheel bearing grease SAE J310, NLGI No.2	As required
Parking brake shoe and backing plate contact surfaces	Bearing grease, NLGI No.0-1	As required
Front caliper guide rod and boot	RX-2 Grease	0.042~0.060 oz. (1.2~1.7g)

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Rear caliper guide rod and boot	Rubber Grease	0.028~0.046 oz. (0.8-1.3g)

SPECIFICATION(ABS&TCS)

Part	Item		Standard value	Remark
HECU (Hydraulic and Electronic Control Unit)	System		4 channel 4 sensor (MGH-20)	• ABS system: ABS & EBD control • FTCS system: ABS & EBD control, brake&engine traction control
	Type		Motor, valve relay integrated type	
	Operating voltage		10V ~ 16V(DC)	
	Operating temperature		-40 ~ 110°C (-40 ~ 230°F)	
	Motor power		180W	
	Pump orifice		Ø0.5 mm (0.0197 in.)	
	Accumulator capacity	LPA	MCS: 3.0cc/MCP: 3.0cc	LPA: Low pressure accumulator
		HPA	0.13cc	HPA: High pressure accumulator
	Valve	Inlet valve (NO)	Front: Ø 0.50mm (0.0197 in.) Rear: Ø 0.315mm (0.0124 in.)	NO valve: 4
		Outlet valve (NC)	Front: Ø 0.56mm (0.0220 in.) Rear: Ø 0.355mm (0.0140 in.)	NC valve: 4
Warning lamp	Operating voltage		12V	• ABS W/L: ABS failure • Brake W/L: Parking, brake oil, EBD failure. • TCS W/L: TCS failure
	Consumption current		80mA	
Wheel speed sensor	Internal resistance		1,385 ± 110Ω	23 ± 5°C (73.4 ± 9°F)
	Output range		15 ~ 2000Hz	
	Min. P-P voltage		130mVp.p (15Hz)	Max. airgab
	Tone wheel		44T	
	Air gap		0.2 ~ 1.3mm (0.0079 ~ 0.0512in.)	

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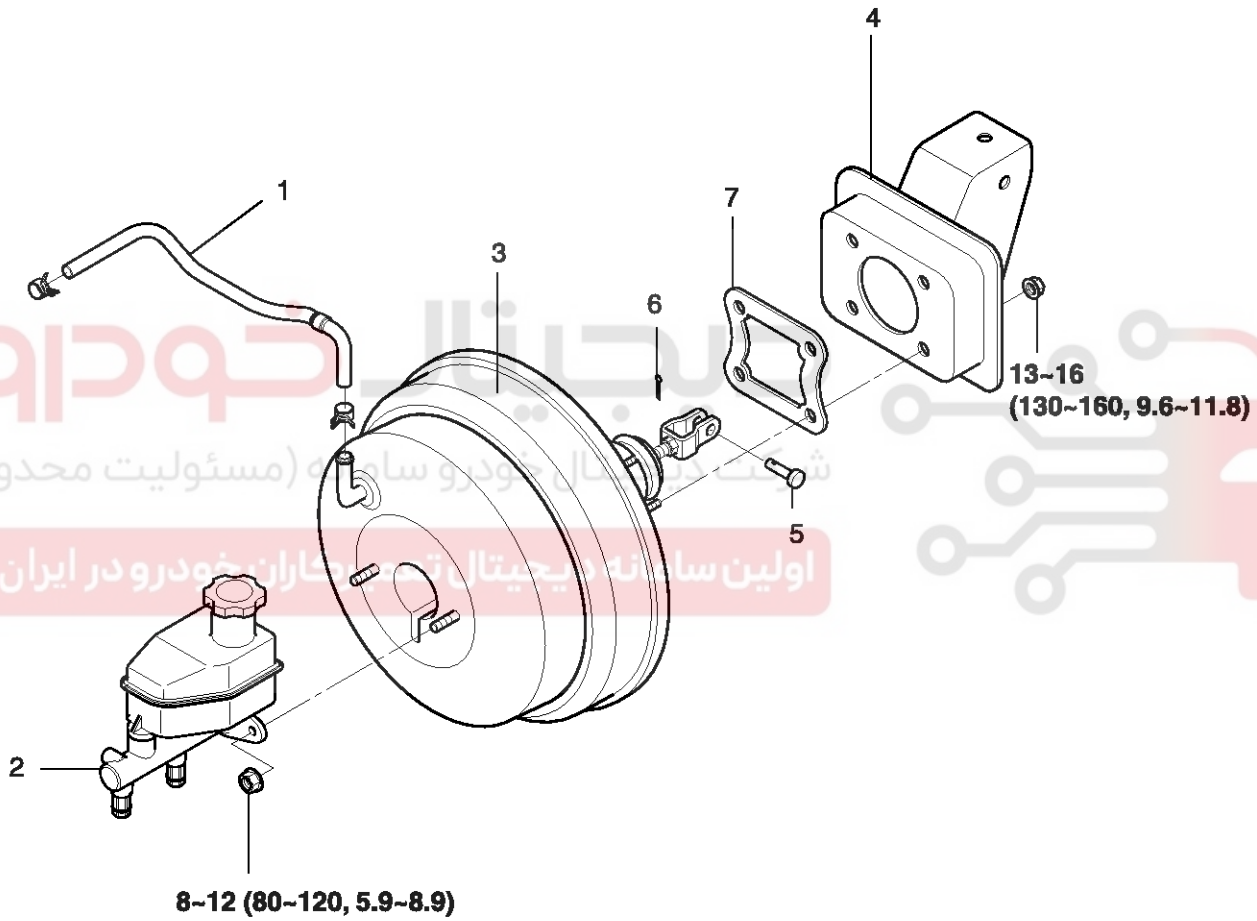
Brake System

Brake System

Brake Booster

COMPONENTS



Torque : N·m (kg·cm, lb·ft)

1. Vacuum hose
2. Master cylinder assembly
3. Booster assembly
4. Member assembly
5. Pin assembly
6. Snap pin
7. Sealer

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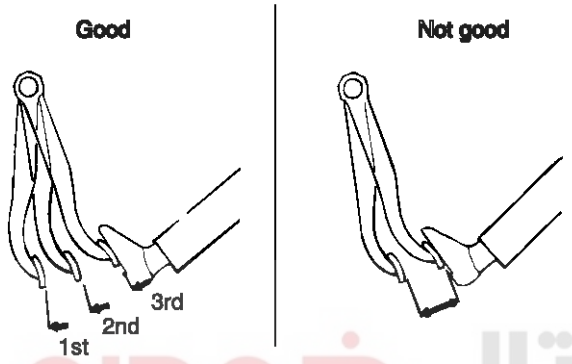
LJGE008D

BRAKE BOOSTER OPERATING TEST

For simple checking of the brake booster operation, carry out the following tests

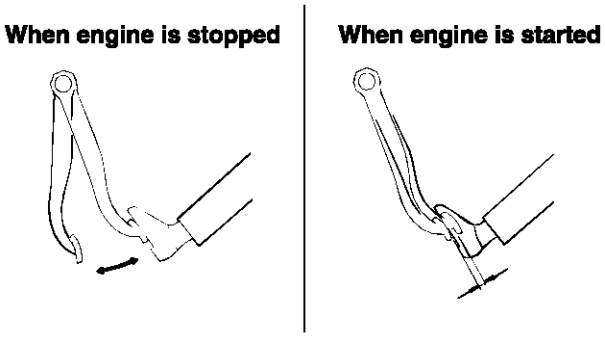
1. Run the engine for one or two minutes, and then stop it. If the pedal depresses fully the first time but gradually becomes higher when depressed succeeding times, the booster is operating properly, if the pedal height remains unchanged, thebooster is defective.



LJCD006F

2. With the engine stopped, step on the brake pedal several times.

   Then step on the brake pedal and start the engine. If the pedal moves downward slightly, the booster is in good condition. If there is no change, the booster is defective



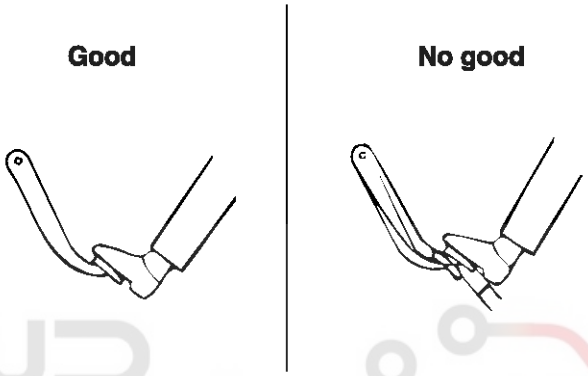
LJCD006G

3. With the engine running, step on the brake pedal and then stop the engine.

   Hold the pedal depressed for 30 seconds. If the pedal height does not change, the booster is in good condition, if the pedal rises, the booster is defective.

   If the above three tests are okay, the booster performance can be determined as good.

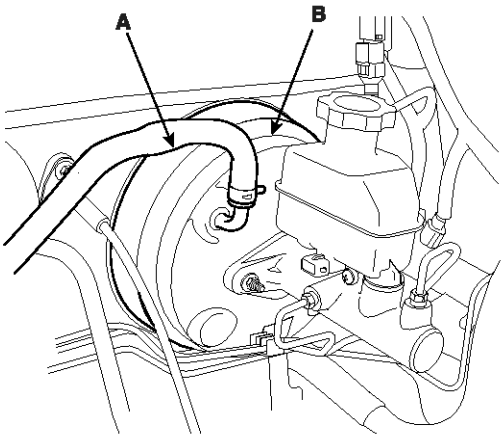
   Even if one of the above three tests is not okay, check the check valve, vacuum hose and booster for defect.



LJCD006H

VACUUM HOSE (CHECK VALVE) INSPECTION

1. Disconnect the brake booster vacuum hose (check valve built in) (A) at the booster (B).
2. Start the engine and let it idle. There should be vacuum available. If no vacuum is available, the check valve is not working properly. Replace the brake booster vacuum hose and check valve and retest.



EJKE300A

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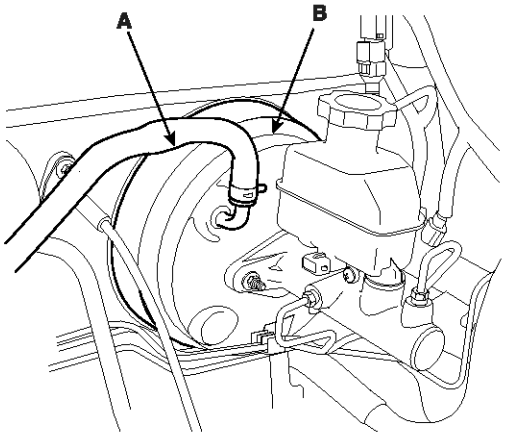
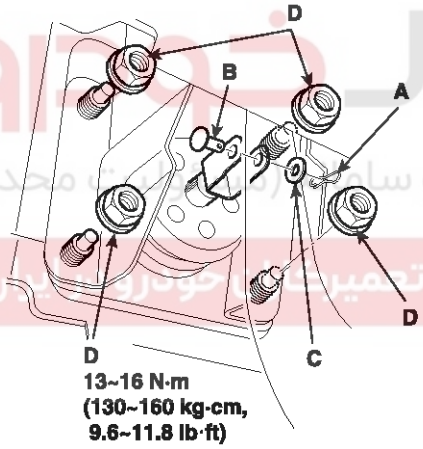
Removal

1. Remove the master cylinder.
2. Disconnect the vacuum hose (A) from the brake booster (B).



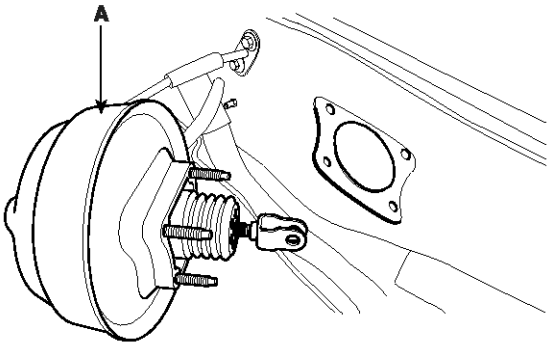
EJKE300A

3. Remove the snap pin (A), pin (B) and washer (C).



LJGE008C

4. Remove the four booster mounting nuts (D).
5. Remove the brake booster (A) from the engine compartment.

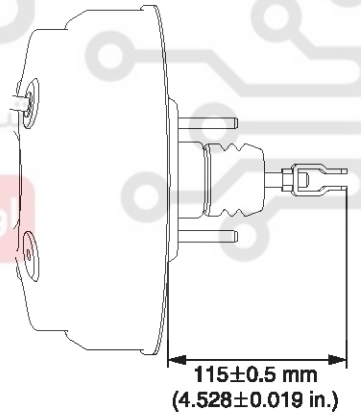


EJKE305D

INSTALLATION

1. Adjust push rod length of the booster, and then install the seal on the booster assembly.

Standard length : 115 ± 0.5 mm (4.528 ± 0.019 in.)



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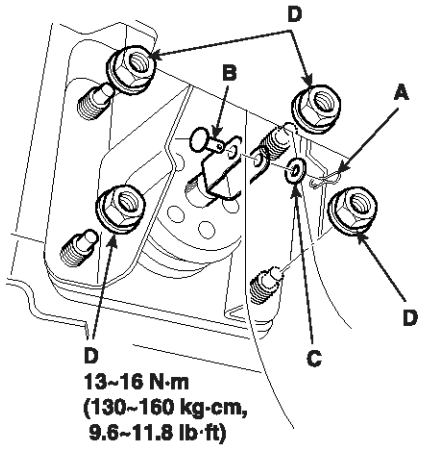
2. Insert the booster and tighten the nut (D).

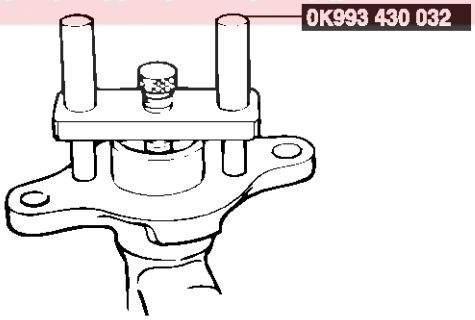


LJGE008C

3. Connect the booster push rod and brake pedal with a pin (B) and install a snap pin (A) to the pin (B).

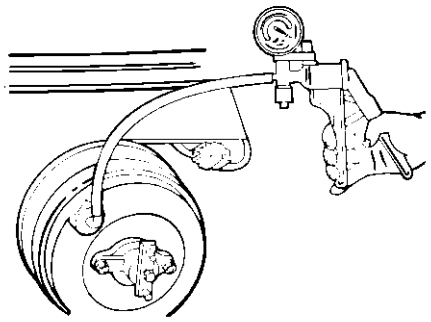
⚠CAUTION
When installing the snap pin, it mount be used new one.

4. Adjust push rod length.
   1) Insert the gasket onto the master cylinder.
   2) Put the SST onto the gasket and tighten the adjusting bolt until the bolt touches the bottom of the push rod hole.



LJAC009C

   3) Apply 500 mmHg vacuums with a vacuum pump.
   4) Invert the SST used in step 2 and place it on the booster.

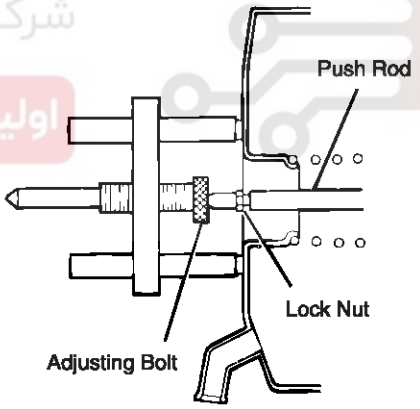


LJAC009D

   5) Check whether the clearance between the edge of the adjusting bolt and the push rod of the booster is 0 - 0.1 mm (0 - 0.004 in.).

      If it is not standard clearance, loosen the lock nut of the push rod, and turn the push rod to make the adjustment.

Standard clearance : 0 ~ 0.1 mm (0 ~ 0.004 in.)



LJAC009E

5. Install the master cylinder.
6. Connect the vacuum hose to the brake booster.
7. After filling the brake reservoir with brake fluid, bleed the system.
8. Check for fluid leakage.
9. Check and adjust the brake pedal for proper operation.
10. After installing, apply grease to the contact parts of the joint pin and brake pedal.

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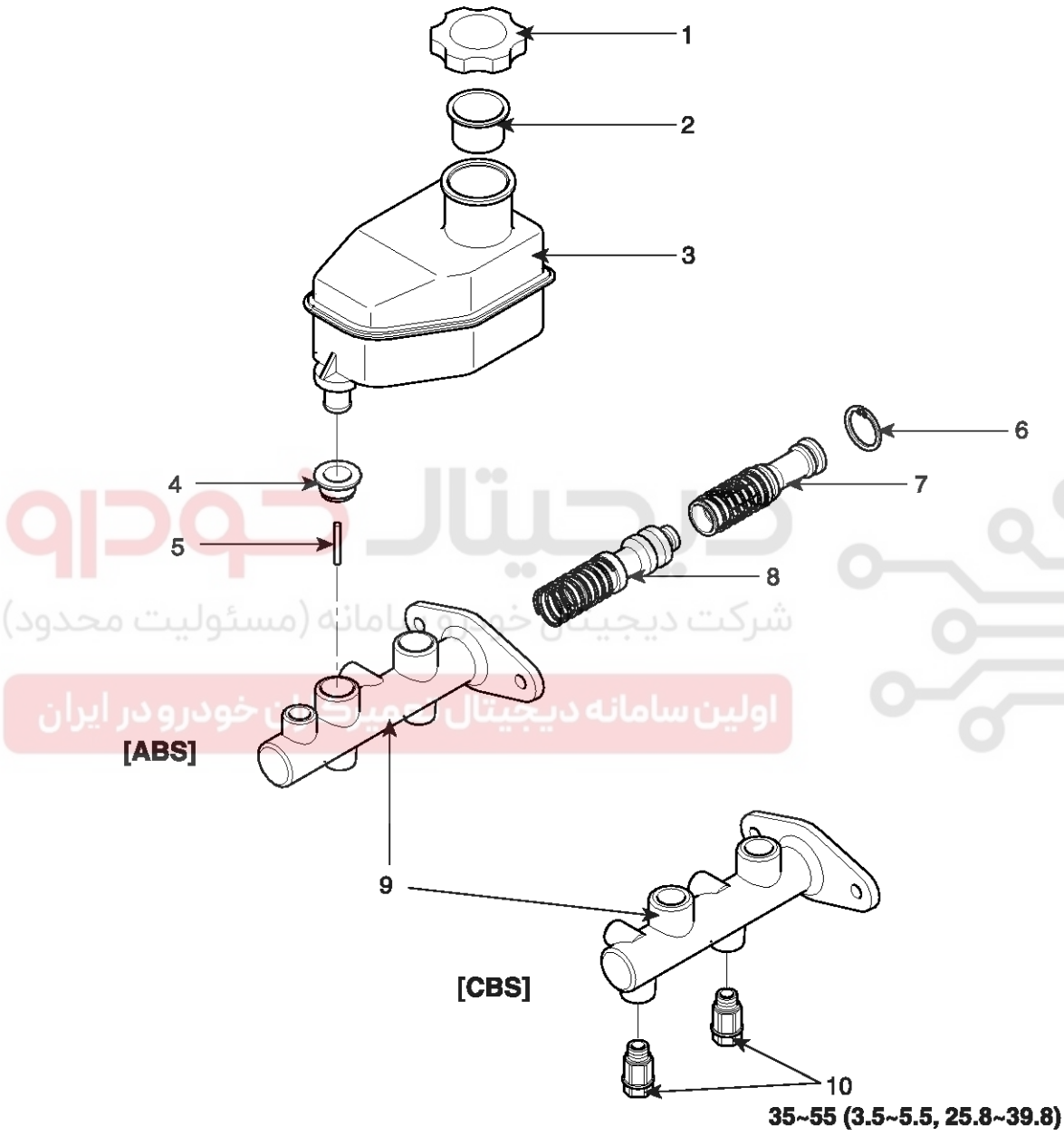
Master Cylinder

COMPONENTS



TORQUE : N·m(kg·m, lb·ft)

1. Reservoir cap
2. Brake fluid filter
3. Reservoir
4. Grommet
5. Cylinder pin
6. Retainer
7. Primary piston assembly
8. Secondary piston assembly
9. Master cylinder body
10. Proportioning valve

LJGE002A

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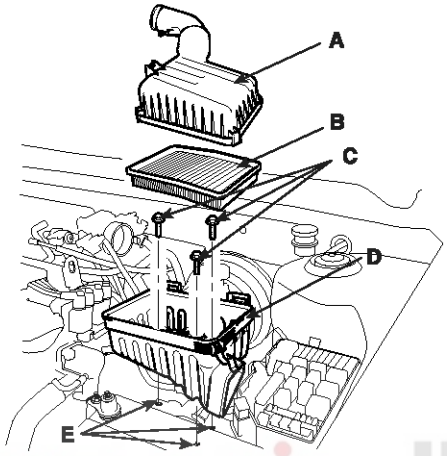
REPLACEMENT

NOTICE

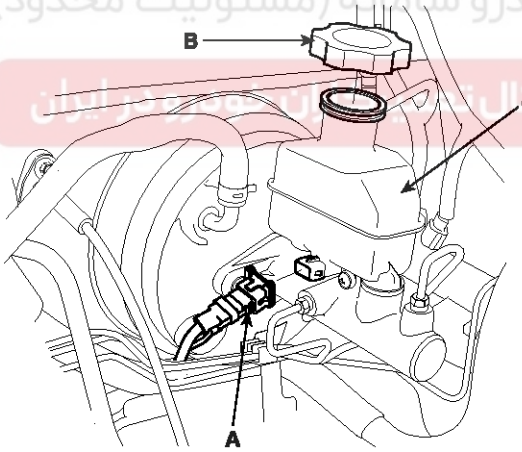
Do not spill brake fluid on the vehicle; it may damage the paint; if brake fluid does contact the paint, wash it off immediately with water.

1. Remove the air cleaner cover (A), air filter (B), air cleaner mounting bolts (C) and air cleaner body (D) from the air cleaner mounting bracket (E).



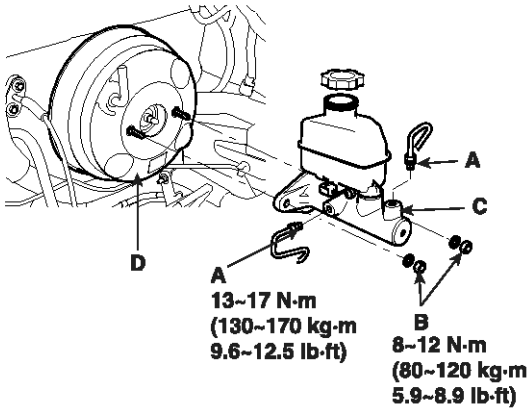
EJKE200E

2. Disconnect the brake fluid level switch connectors (A), and remove the reservoir cap (B).



EJKE200F

3. Remove the brake fluid from the master cylinder reservoir (C) with a syringe.
4. Disconnect the brake lines (A) from the master cylinder. To prevent spills, cover the hose joints with rags or shop towels.

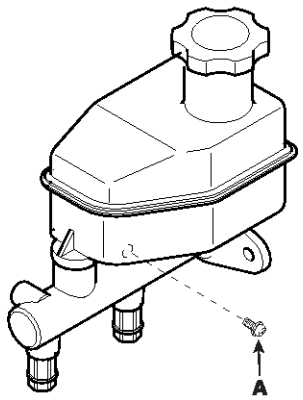


EJKE200C

5. Remove the master cylinder mounting nuts (B) and washers.
6. Remove the master cylinder(C) from the brake booster (D). Be careful not to bend or damage the brake lines when removing the master cylinder.
7. Install the master cylinder in the reverse order of removal, and note these items:
   - Replace all rubber parts with new ones whenever, removed.

DISASSEMBLY

1. Remove the reservoir cap and drain the brake fluid into a suitable container.
2. Remove the fluid level sensor.
3. Remove the reservoir from the master cylinder after mounting screw (A).



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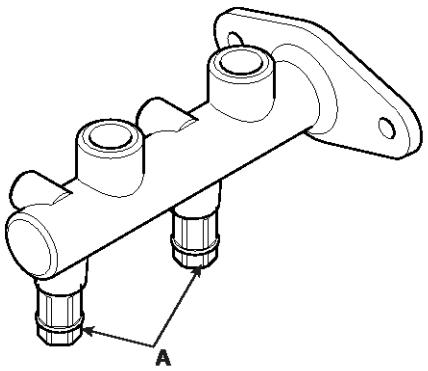
4. Remove the proportioning valves (A) - Conventional brake system.



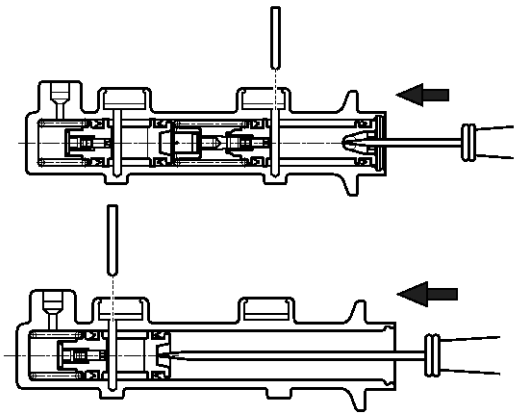
AJGE026D

5. Remove the retainer ring by using the snap ring pliers.

EJA9009C

6. Remove the pin with the primary piston pushed completely using a screwdriver. Remove the primary piston assembly.

7. Remove the pin with the secondary piston pushed completely using a screwdriver. Remove the secondary piston assembly.



AJCD026C

NOTICE

Do not disassemble the primary and secondary piston assembly.

INSPECTION

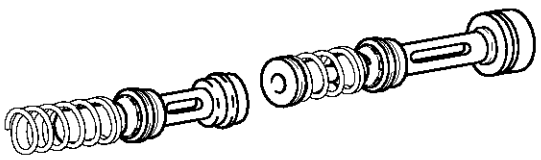
1. Check the master cylinder bore for rust or scratch.
2. Check the master cylinder for wear or damage. If necessary, clean or replace the cylinder.

CAUTION

- **If the cylinder bore is damaged, replace the master cylinder assembly.**
- **Wash the contaminated parts in alcohol.**

REASSEMBLY

1. Apply genuine brake fluid to the rubber parts of the cylinder kit and grommets.
2. Carefully insert the springs and pistons in the proper direction.



AJCD028A

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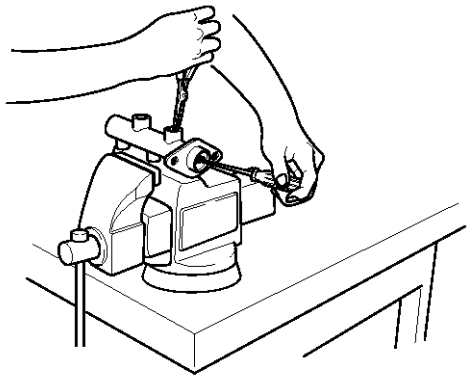
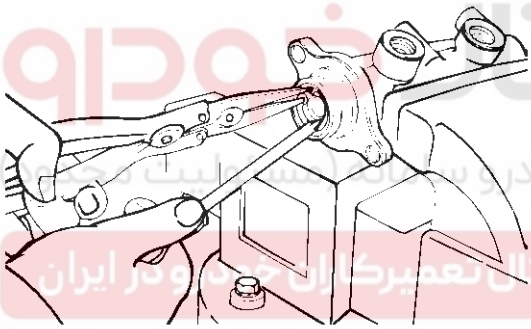
3. Press the piston with a screwdriver and install the cylinder pin.



AJCD026B

4. Press the piston with a screwdriver and install the snap ring.



LJAC026B

5. Install the proportioning valves.
6. Mount two grommets.
7. Install the reservoir on the cylinder.

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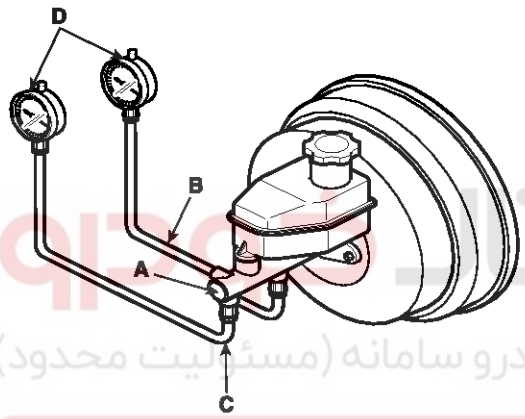
Proportioning Valve

DESCRIPTION

Do not disassemble the proportioning valve. The proportioning valve makes the ideal distribution of fluid pressure to the front and rear brakes to prevent the brakes from skidding in the event of rear wheel lock up and to obtain a higher brake efficiency within the range of service brake application.

Proportioning valve function test

1. Remove the front brake tube (B) and rear brake tube (C) from the master cylinder (A).
2. Connect two pressure gauges (D); one to the output valve of the front (B) and rear (C) brake.



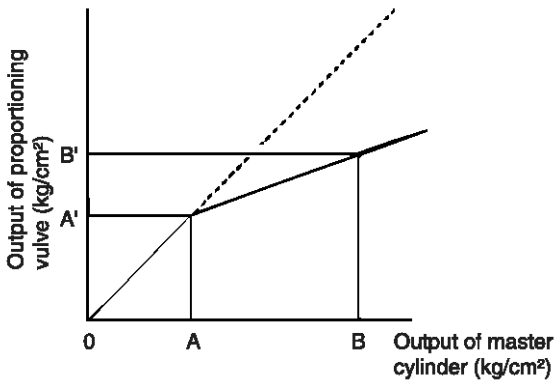
AJGE026G

NOTICE

Be sure to bleed the system after connecting the pressure gauges.

3. With the brake applied, measure the front pressure and the rear pressure.

   If the measured pressures are within the specified range as illustrated, the proportioning valve is good.



LJGE026E

4. Reconnect the brake lines in their original positions and bleed the system.

NOTICE

This table shows characteristics of the proportioning valve as the pressure increases.

Front (Output of master cylinder)	Rear (Output of proportioning valve)
A : 26 kg/cm² (2.55MPa, 370psi)	A' : 26 kg/cm² (2.55MPa, 370psi)
B : 80 kg/cm² (7.84MPa, 1137psi)	B' : 40.6 ± 3 kg/cm² (3.98 ± 0.3MPa, 577 ± 42 psi)

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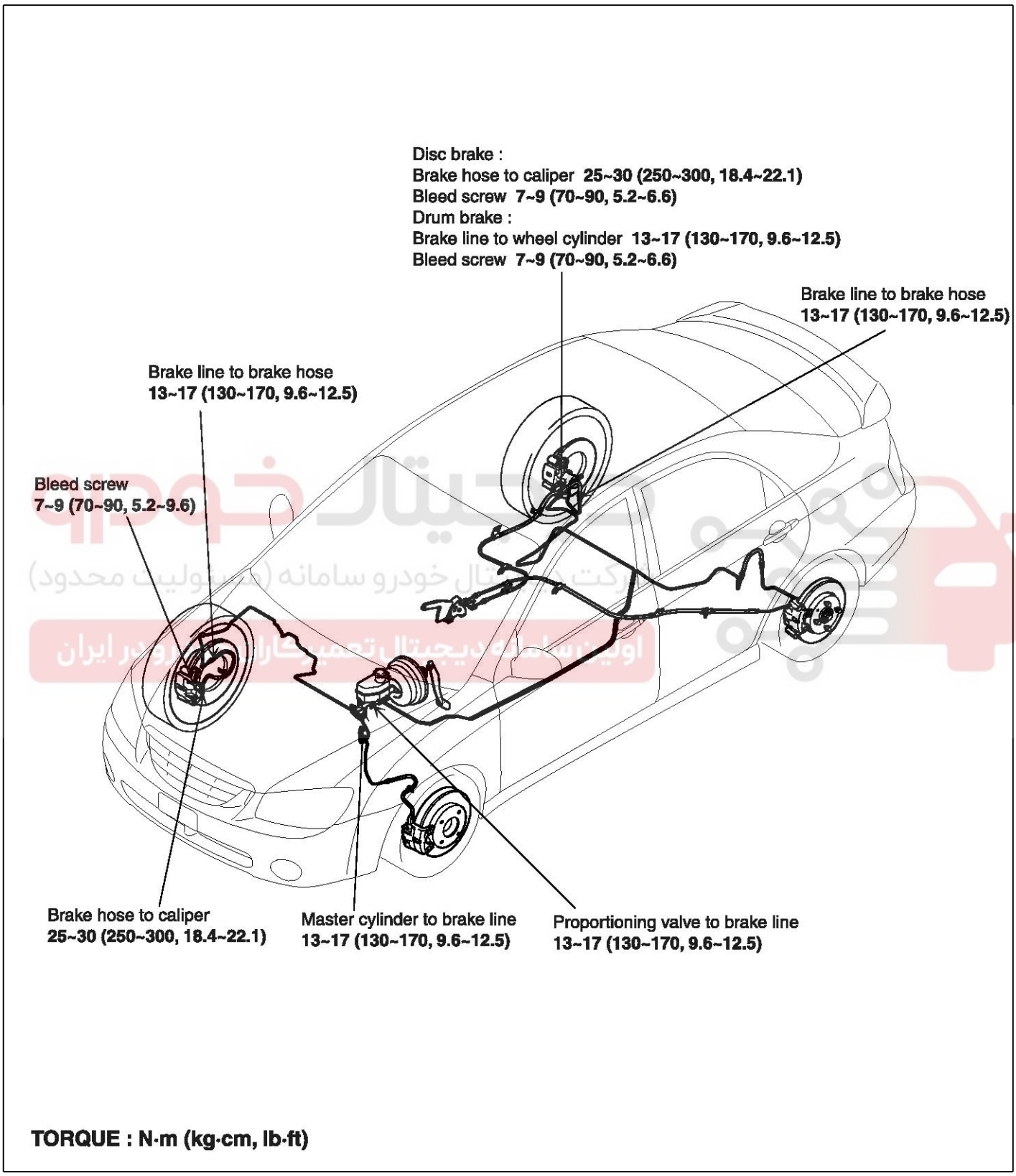
Brake Line

COMPONENTS



LJGE001B

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INSPECTION

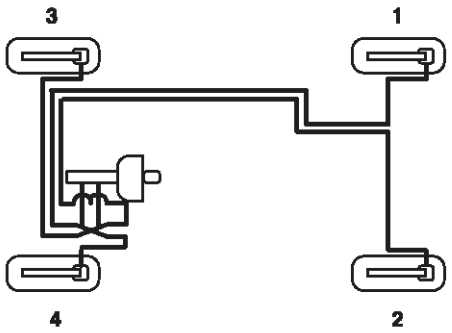
1. Inspect the brake hoses, for damage, deterioration, leaks, interference and twisting.
2. Check the brake lines for damage, rusting, and leakage. Also check for bent brake lines.
3. Check for leaks at hose and line joints or connections, and retighten if necessary.
4. Check the master cylinder for damage and leakage.
5. Replace the brake hose clip whenever the brake hose is serviced.

Brake system bleeding

NOTICE

- *Do not reuse the drained fluid.*
- *Always use Genuine DOT 3 or DOT 4 Brake Fluid. Using a non-Genuine DOT3 or DOT 4 brake fluid can cause corrosion and decrease the life of the system.*
- *Make sure no dirt of other foreign matter is allowed to contaminate the brake fluid.*
- *Do not spill brake fluid on the vehicle, it may damage the paint; if brake fluid does contact the paint, wash it off immediately with water.*
- *The reservoir on the master cylinder must be at the MAX (upper) level mark at the start of bleeding procedure and checked after bleeding each brake caliper. Add fluid as required.*

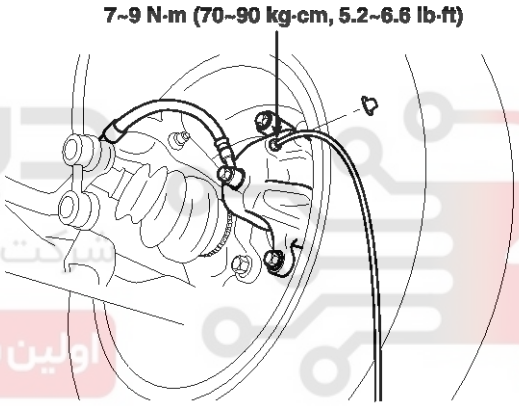
1. Make sure the brake fluid level in the reservoir is at the MAX (upper) level line.
2. Have someone slowly pump the brake pedal several times, and then apply steady pressure.
3. Loosen the right-rear brake bleed screw to allow air to escape from the system. Then tighten the bleed screw securely.
4. Repeat the procedure for each wheel in the sequence shown below until air bubbles no longer appear in the fluid.



AJCD007C

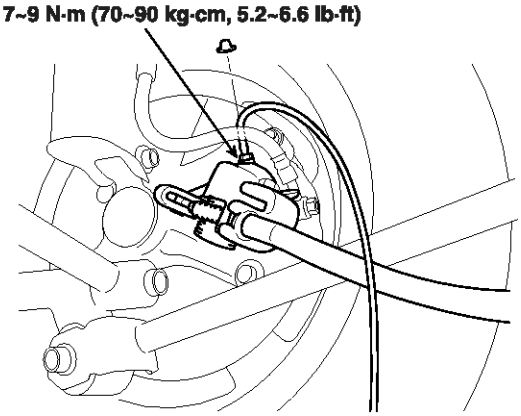
5. Refill the master cylinder reservoir to the MAX (upper) level line.

Front disc brake:



LJGE001C

Rear disc brake:



LJGE001D

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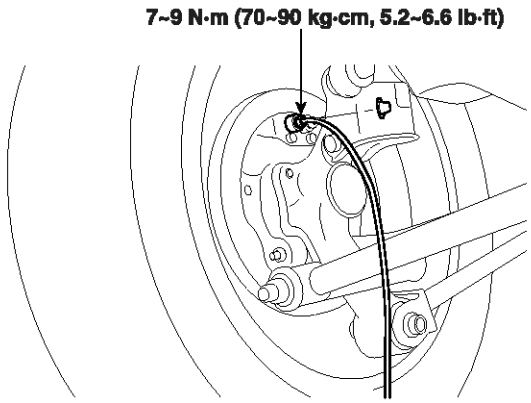
Rear drum brake:



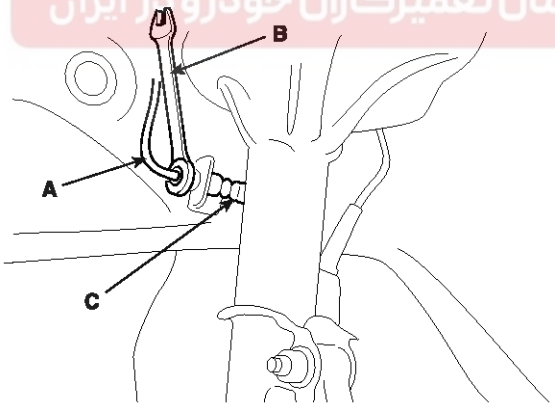
LJGE001E

REPLACEMENT

NOTICE

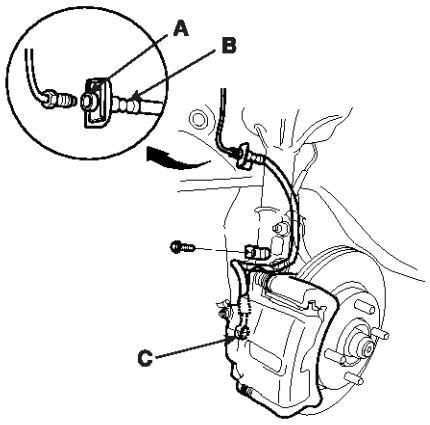
- *Before reassembling, check that all parts are free of dust and other foreign particles.*
- *Replace parts with new ones whenever specified to do so.*
- *Do not spill brake fluid on the vehicle; it may damage the paint; if brake fluid gets on the paint, wash it off immediately with water.*

1. Replace the brake tube (A) if the tube is twisted, cracked, or if it leaks.



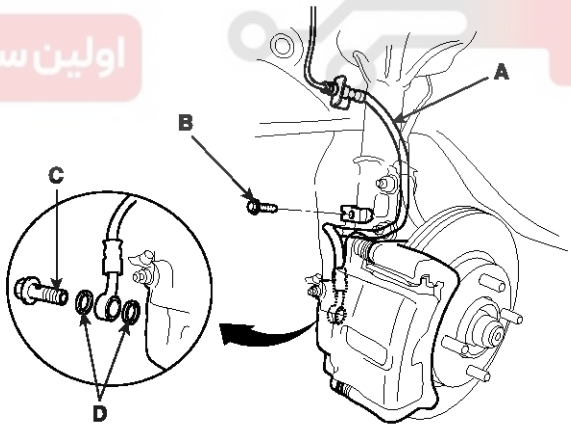
EJKE050A

2. Disconnect the brake hose from the brake line (B) using a 10mm(0.39in.) flare-nut wrench (C).
3. Remove and discard the brake hose clip (A) from the brake hose (B).



EJKE050B

4. Remove the connector bolt (C), and disconnect the brake hose from the caliper.
5. Remove the brake hose from the knuckle.
6. Install the brake hose (A) on the knuckle with 12mm(0.47in.) flange bolt (B) first, then connect the brake hose to the caliper with the connector bolt (C) and new sealing washers (D).



EJKE050C

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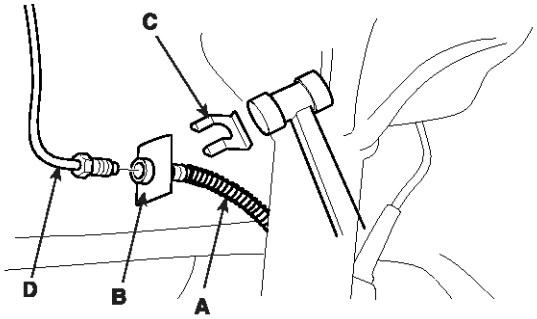
7. Install the brake hose (A) on the upper brake hose bracket (B) with a new brake hose clip (C).



EJKE050D

8. Connect the brake line (D) to the brake hose.
9. After installing the brake hose, bleed the brake system.
10. Perform the following checks.
    - Check the brake hose and line joint for leaks, and tighten if necessary.
    - Check the brake hoses for interference and twisting.

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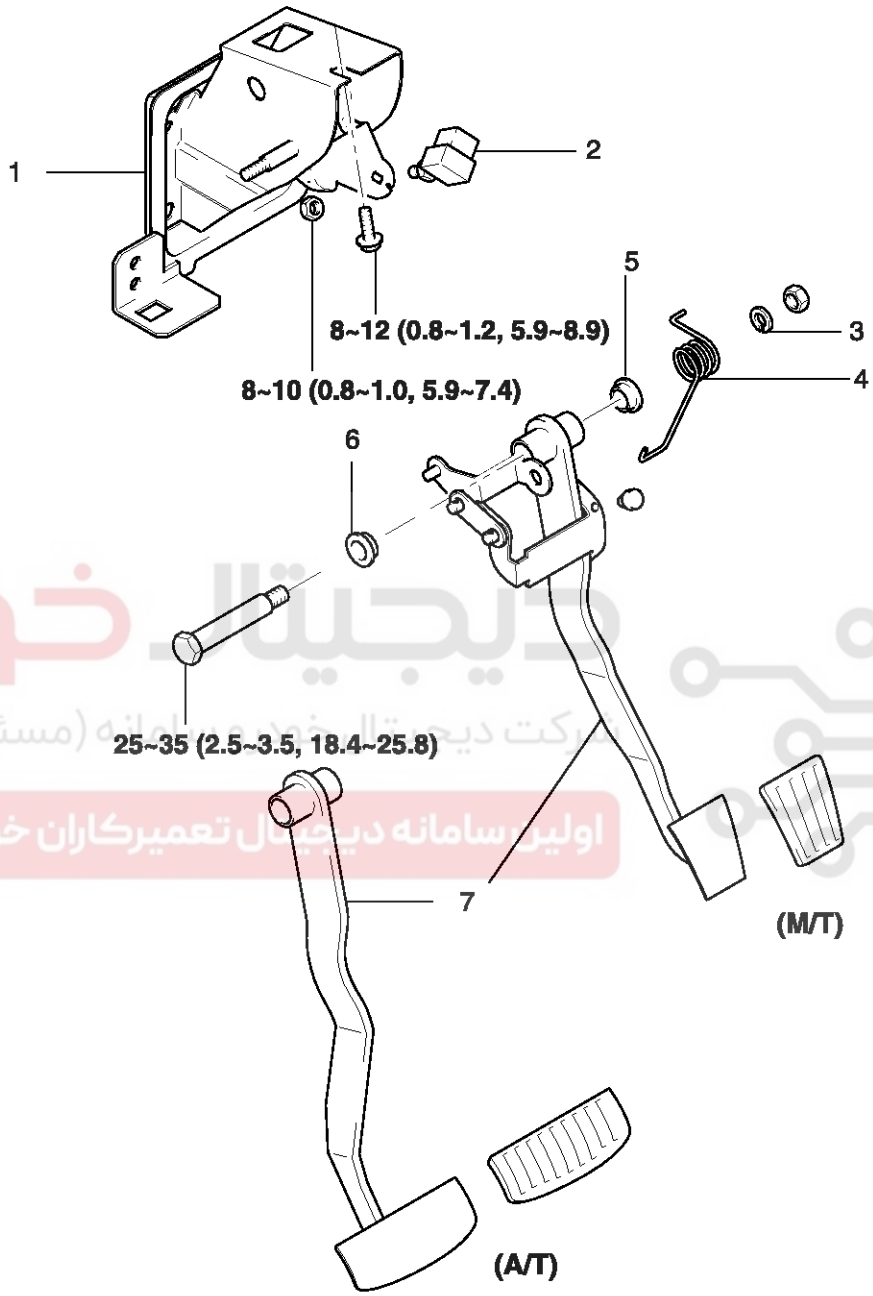
Brake Pedal

COMPONENTS



TORQUE : N·m (kg·m, lb·ft)

1. Member assembly bracket
2. Stop lamp switch
3. Washer
4. Return spring
5. Bushing
6. Bushing
7. Brake pedal

LJGE014A

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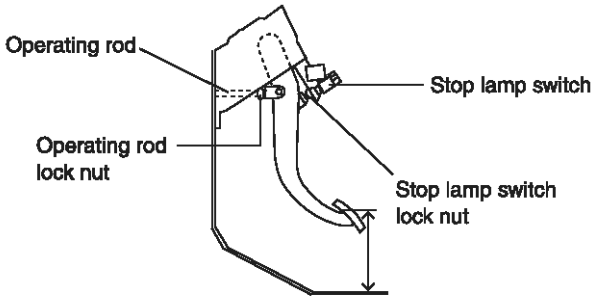
SERVICE ADJUSTMENT

PROCEDURES

PEDAL HEIGHT

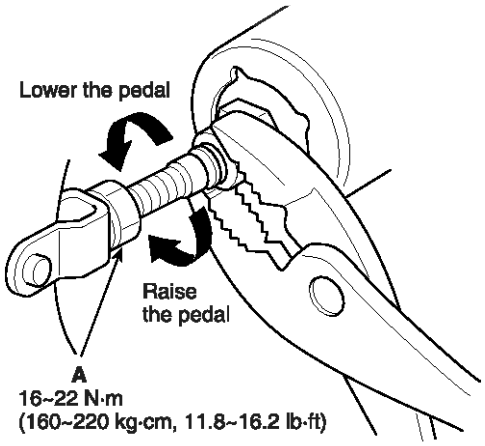
1. Measure the brake pedal height. If the brake pedal height is not within the standard value, adjust as follows.

Standard value : 189 mm (7.24 in.)



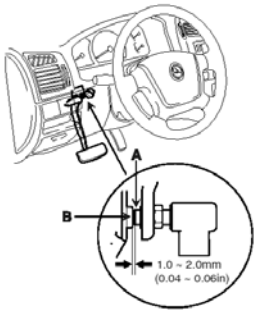
LJCD006K

2. Disconnect the stop lamp switch connector, loosen the lock nut(A), and move the stop lamp switch to a position where it does not contact the brake pedal arm.
3. Adjust the brake pedal height by turning the operating rod with pliers (with the operating rod lock nut loosened), until the correct brake pedal height is obtained.



EJKE001B

4. After turning the stop lamp switch(A) until it contacts the brake pedal stopper(B) (just before the brake pedal is caused to move), return the stop lamp switch 1/2 to 1 turn and secure by tightening the lock nut.



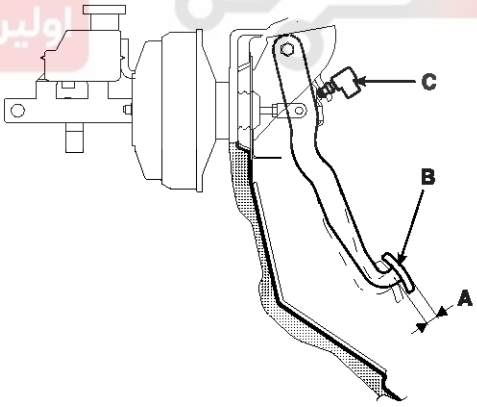
SLDBR8499L

5. Connect the connector of the stop lamp switch.
6. Check that the stop lamp is not illuminated with the brake pedal unpressed.

PEDAL FREE PLAY

1. With the engine stopped, depress the brake pedal two or three times. After eliminating the vacuum in the power brake booster, press the pedal down by hand, and confirm that the amount of movement before resistance is met (the free play) is within the standard value.

Standard value : 3 - 8 mm (0.117 - 0.312 in.)



EJKE001D

2. If free play does not reach the standard value, check that clearance between the outer case of stop light switch and brake pedal is within the standard value.

   If free play exceeds the standard value, it is probably due to excessive clearance between the clevis pin and brake pedal arm.

   Check for excessive clearance and replace faulty parts as required.

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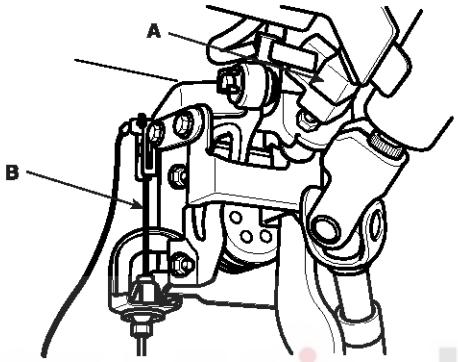
3. Start the engine, depress the brake pedal with approximately 120kg(1176.8N, 264.5 lb) of force, and check for oil leakage in the master cylinder, brake line and each connecting part.

   Repair the faulty parts as required.

REMOVAL

1. Remove the lower crash pad.
2. Remove the stop lamp switch connector (A).
3. Remove the shift lock cable (B)(A/T).



AJGE014B

4. Remove the pin and snap pin.
5. Remove the brake pedal member assembly mounting nuts and then remove the brake pedal assembly.

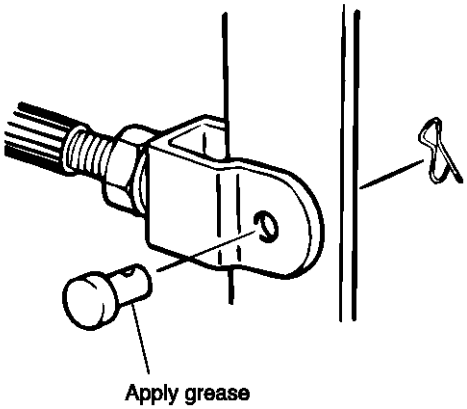
INSTALLATION

1. Installation is the reverse of removal.

   ⚠CAUTION

   Coat the inner surface of the bushings with the specified grease.

2. Before inserting the pin, apply the specified grease to the joint pin.



LJAC009B

3. Adjust the brake pedal height and free play.
4. Install the stop lamp switch.

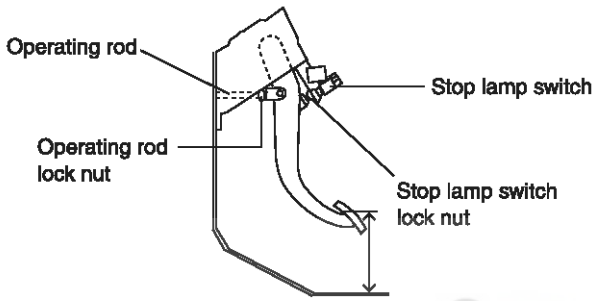
SERVICE ADJUSTMENT

PROCEDURES

PEDAL HEIGHT

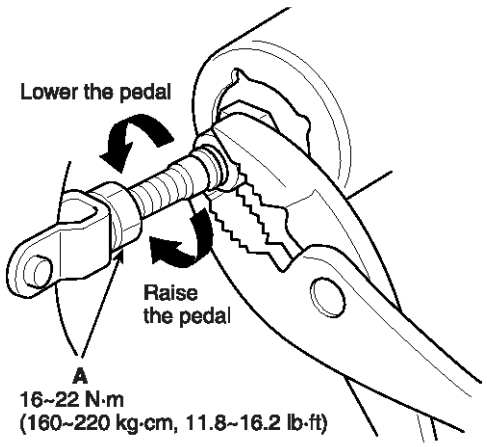
1. Measure the brake pedal height. If the brake pedal height is not within the standard value, adjust as follows.

Standard value : 189 mm (7.24 in.)



LJCD006K

2. Disconnect the stop lamp switch connector, loosen the lock nut(A), and move the stop lamp switch to a position where it does not contact the brake pedal arm.
3. Adjust the brake pedal height by turning the operating rod with pliers (with the operating rod lock nut loosened), until the correct brake pedal height is obtained.



EJKE001B

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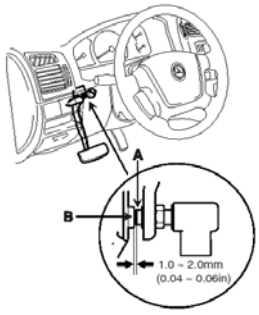
4. After turning the stop lamp switch(A) until it contacts the brake pedal stopper(B) (just before the brake pedal is caused to move), return the stop lamp switch 1/2 to 1 turn and secure by tightening the lock nut.



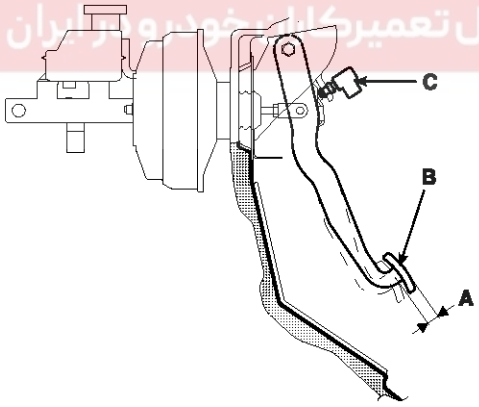
SLDBR8499L

5. Connect the connector of the stop lamp switch.
6. Check that the stop lamp is not illuminated with the brake pedal unpressed.

PEDAL FREE PLAY

1. With the engine stopped, depress the brake pedal two or three times. After eliminating the vacuum in the power brake booster, press the pedal down by hand, and confirm that the amount of movement before resistance is met (the free play) is within the standard value.

Standard value : 3 - 8 mm (0.117 - 0.312 in.)



EJKE001D

2. If free play does not reach the standard value, check that clearance between the outer case of stop light switch and brake pedal is within the standard value.

   If free play exceeds the standard value, it is probably due to excessive clearance between the clevis pin and brake pedal arm.

   Check for excessive clearance and replace faulty parts as required.
3. Start the engine, depress the brake pedal with approximately 120kg(1176.8N, 264.5 lb) of force, and check for oil leakage in the master cylinder, brake line and each connecting part.

   Repair the faulty parts as required.

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Front Disc Brake

General information

⚠CAUTION

Frequent inhalation of brake pad dust, regardless of material composition, could be hazardous to your health.

- **Avoid breathing dust particles.**
- **Never use an air hose or brush to clean brake assemblies.**

Remove, disassemble, inspect, reassemble, and install the caliper and note these items:

- Do not spill brake fluid on the vehicle; it may damage the paint; if brake fluid gets on the paint, wash it off immediately with water.
- To prevent dripping, cover disconnected hose joints with rags or shop towels.
- Clean all parts in brake fluid and air dry; blow out all passages with compressed air.
- Before reassembling, check that all parts are free of dirt and other foreign particles.
- Replace parts with new ones as specified in the illustration.
- Make sure no dirt or other foreign matter gets into the brake fluid.
- Make sure no grease or oil gets on the brake discs or pads.
- When reusing pads, always reinstall them in their original positions to prevent loss of braking efficiency.
- Do not reuse drained brake fluid.
- Always use Genuine DOT 3 or DOT 4 brake fluid. Non Genuine DOT 3 or DOT 4 brake fluid can cause corrosion and shorten the life of the system.
- Coat the piston, piston seal groove, and caliper bore with clean brake fluid.
- Replace all rubber parts with new ones.
- After installing the caliper, check the brake hose and line for leaks, interference, and twisting.

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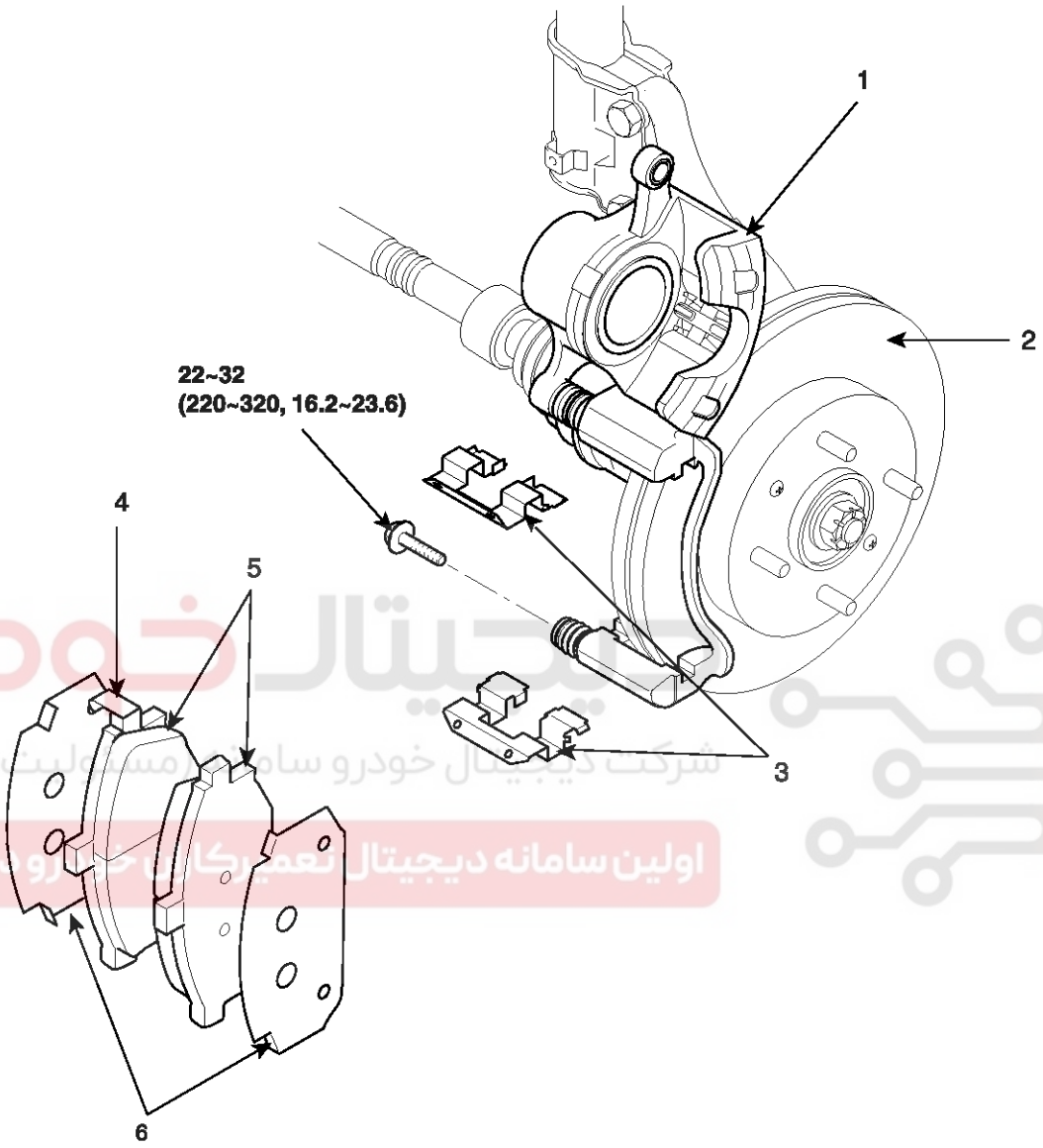
COMPONENTS(1)



TORQUE: N·m (kg·cm, lb·ft)

1. Brake caliper
2. Brake disc
3. Pad retainers
4. Indicator
5. Brake pads
6. Brake pad shims

LJGE003A

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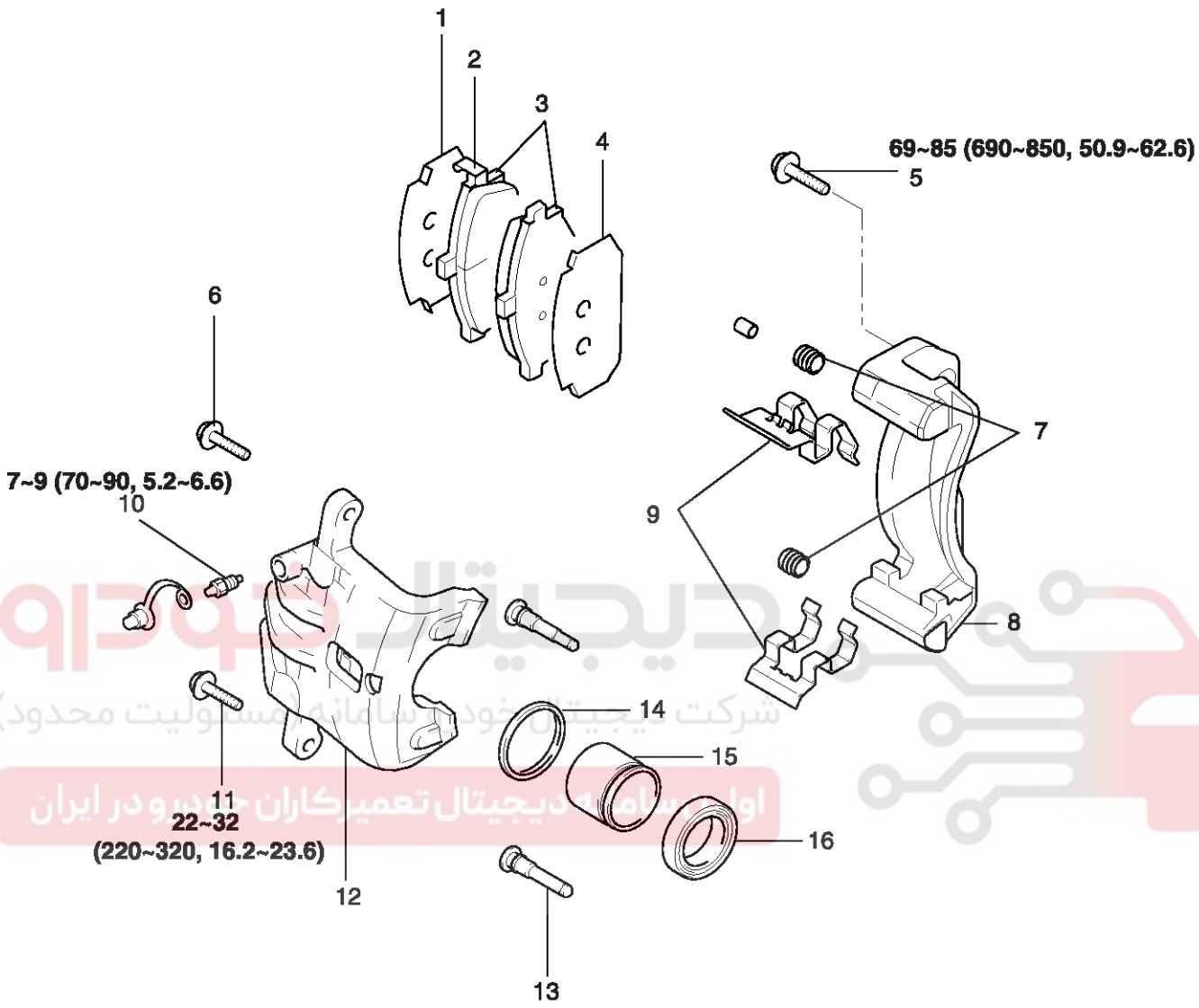
COMPONENTS(2)



TORQUE : N·m (kg·cm, lb·ft)

1. Inner shim
2. Indicator
3. Brake pad
4. Outer shim
5. Caliper mounting bolt
6. Guide rod bolt
7. Pin boot
8. Caliper bracket
9. Pad retainers
10. Bleed screw
11. Guide rod bolt
12. Caliper body
13. Guide pin
14. Piston seal
15. Piston
16. Piston boot

LJGE003B

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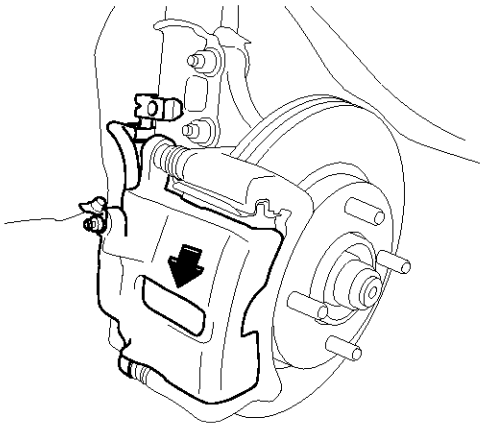
INSPECTION OF FRONT DISC BRAKE PAD

1. Check the brake pad thickness through the caliper body inspection hole.

Pad thickness
Standard value : 11.0 mm (0.43 in.)
Service limit : 2.0 mm (0.0787 in.)



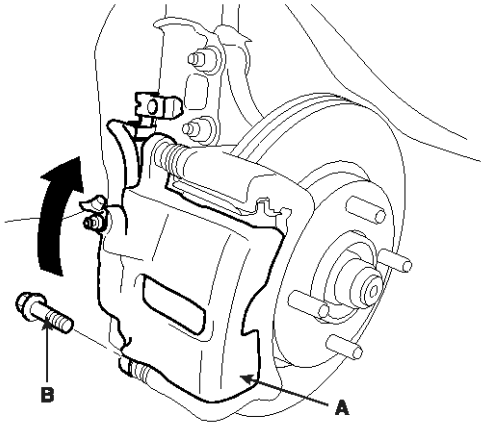
AJGE018A

⚠CAUTION

- **If the pad lining thickness is out of specification, left and right pads must be replaced as a complete set.**
- **When the thickness difference between the left pad and right pad is large, check the sliding condition of the piston and the guide rod.**

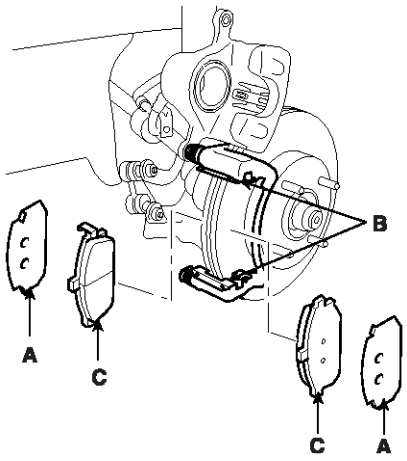
REMOVAL

1. Remove guide rod (B) and the caliper (C) up out of the way. Check the hoses and pin boots for damage and deterioration.



AJGE018B

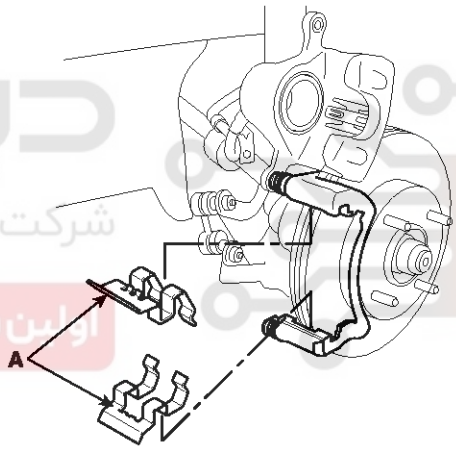
2. Remove the pad shims (A), pad retainers (B) and pads (C).



EJKE400B

INSTALLATION

1. Install the pad retainers (A).



EJKE400D

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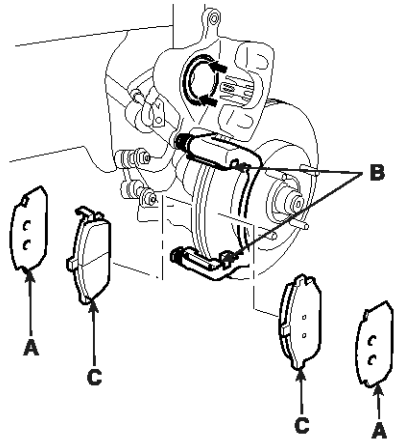
2. Check the foreign material at the pad shims (A) and the back of the pads (B).

   Contaminated brake discs or pads reduce stopping ability. Keep grease off the discs and pads.



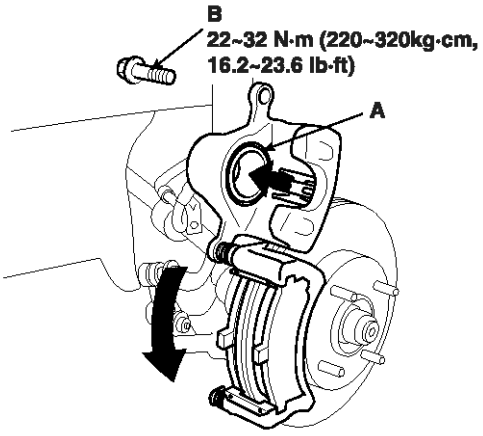
AJGE018D

3. Install the brake pads (B) and pad shims (A) correctly. Install the pad with the wear indicator (C) on the inside.

   If you are reusing the pads, always reinstall the brake pads in their original positions to prevent a momentary loss of braking efficiency.

4. Push in the piston (A) so that the caliper will fit over the pads. Make sure that the piston boot is in position to prevent damaging it when pivoting the caliper down.

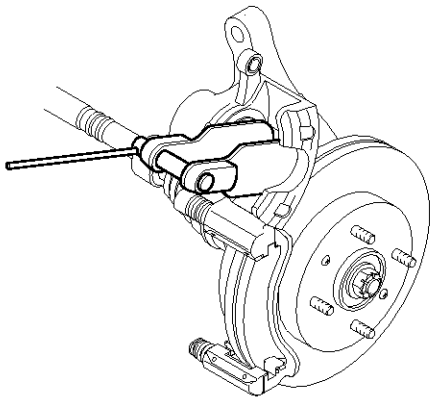
5. Pivot the caliper down into position. Being careful not to damage the pin boot, install the guide rod bolt (B) and torque it to proper specification.



LJGE018C

NOTICE

Insert the piston in the cylinder using the special tool (09581-11000).



EJKE400G

6. Depress the brake pedal several times to make sure the brakes work, then test-drive.

NOTICE

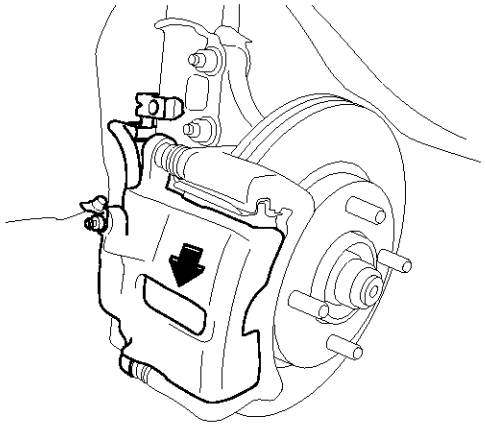
Engagement of the brake may require a greater pedal stroke immediately after the brake pads have been replaced as a set.Several applications of the brake will restore the normal pedal stroke.

7. After installation, check for leaks at hose and line joints or connections, and retighten if necessary.

INSPECTION OF FRONT DISC BRAKE PAD

1. Check the brake pad thickness through the caliper body inspection hole.

Pad thickness
Standard value : 11.0 mm (0.43 in.)
Service limit : 2.0 mm (0.0787 in.)



AJGE018A

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⚠CAUTION

- **If the pad lining thickness is out of specification, left and right pads must be replaced as a complete set.**
- **When the thickness difference between the left pad and right pad is large, check the sliding condition of the piston and the guide rod.**

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Rear Disc Brake

General information

⚠CAUTION

Frequent inhalation of brake pad dust, regardless of material composition, could be hazardous to your health.

- **Avoid breathing dust particles.**
- **Never use an air hose or brush to clean brake assemblies.**

Remove, disassemble, inspect, reassemble, and install the caliper and note these items:

- Do not spill brake fluid on the vehicle; it may damage the paint; if brake fluid gets on the paint, wash it off immediately with water.
- To prevent dripping, cover disconnected hose joints with rags or shop towels.
- Clean all parts in brake fluid and air dry; blow out all passages with compressed air.
- Before reassembling, check that all parts are free of dirt and other foreign particles.
- Replace parts with new ones as specified in the illustration.
- Make sure no dirt or other foreign matter gets into the brake fluid.
- Make sure no grease or oil gets on the brake discs or pads.
- When reusing pads, always reinstall them in their original positions to prevent loss of braking efficiency.
- Do not reuse drained brake fluid.
- Always use Genuine DOT 3 or DOT 4 brake fluid. Non Genuine DOT 3 or DOT 4 brake fluid can cause corrosion and shorten the life of the system.
- Coat the piston, piston seal groove, and caliper bore with clean brake fluid.
- Replace all rubber parts with new ones.
- After installing the caliper, check the brake hose and line for leaks, interference, and twisting.

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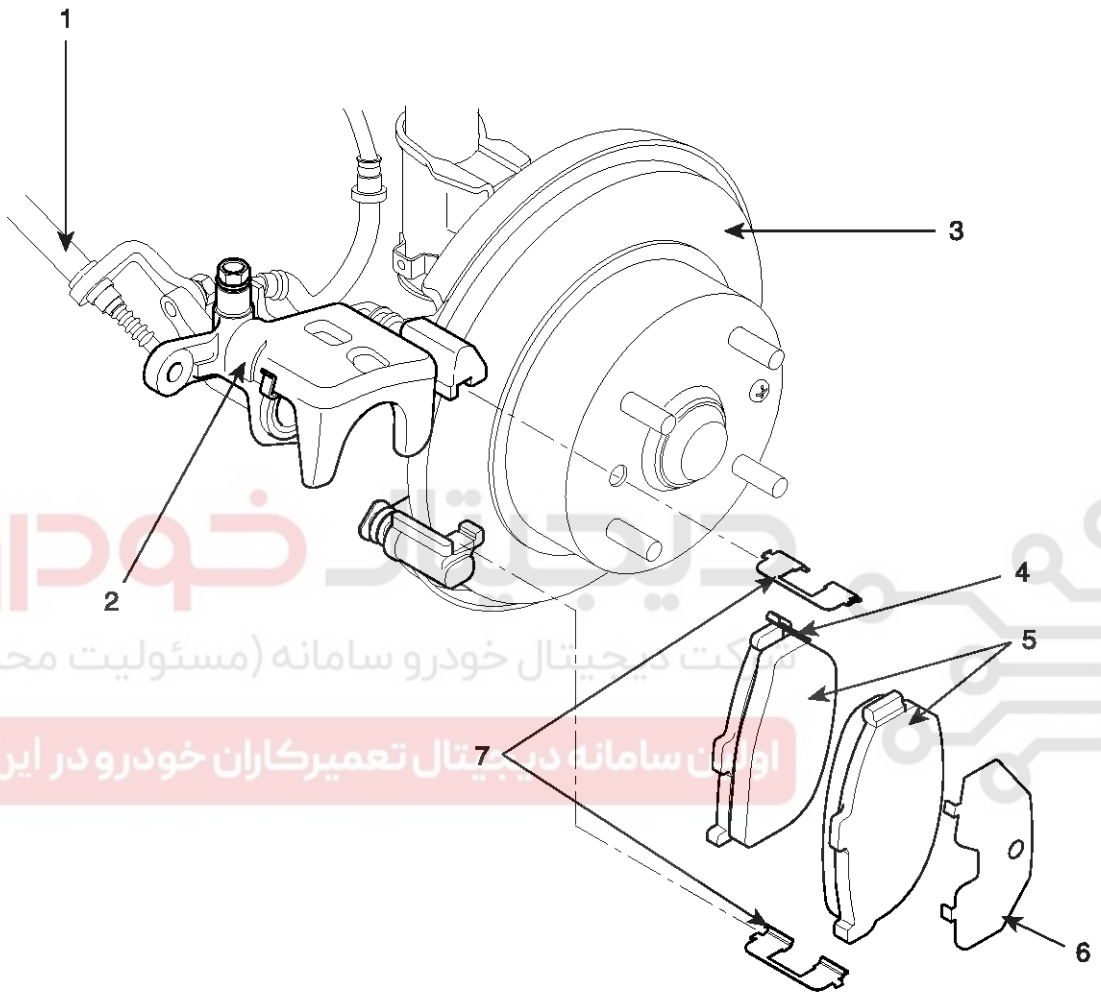
COMPONENTS(1)



1. Parking brake cable
2. Brake caliper
3. Brake disc
4. Indicator
5. Brake pads
6. Brake pad shim
7. Pad retainers

LJGE004A

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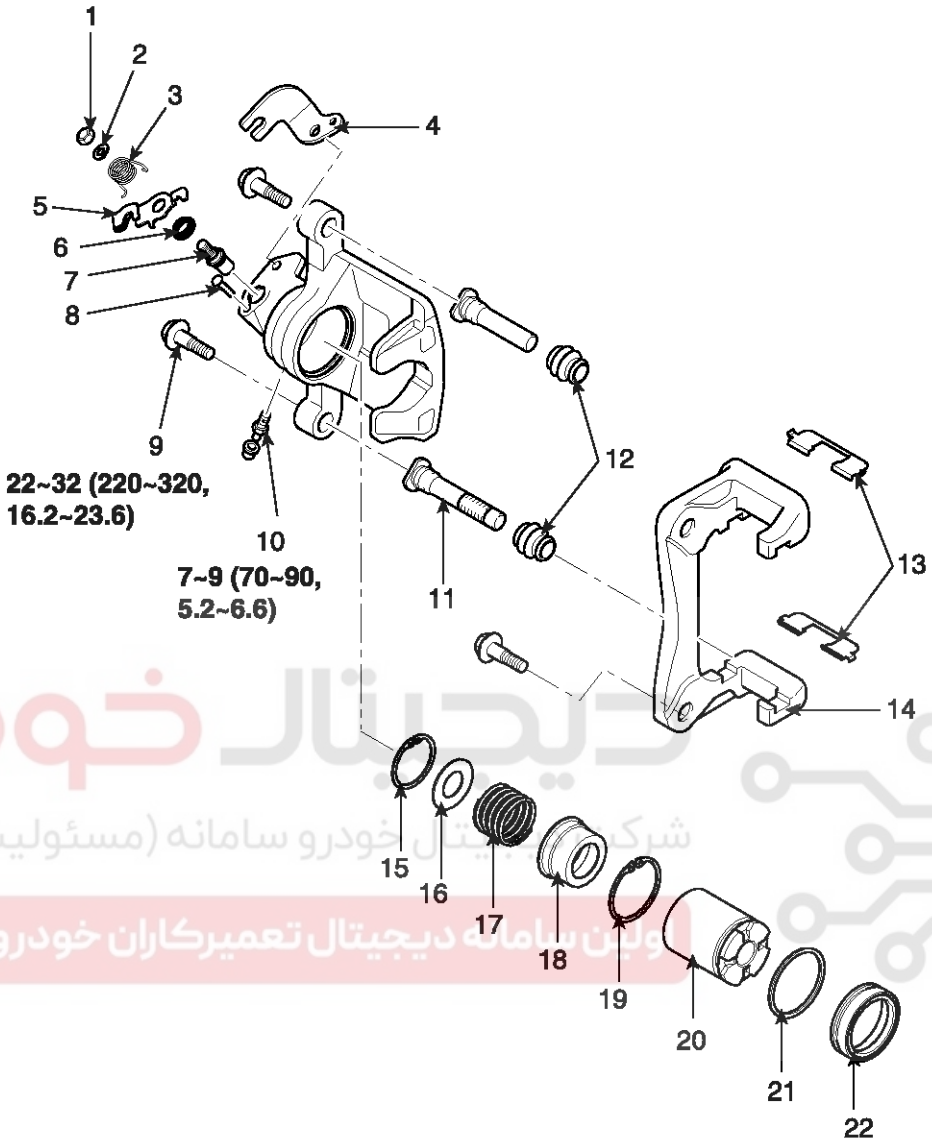
COMPONENTS(2)



TORQUE: N·m (kg·cm, lb·ft)

1. Parking nut
2. Spring washer
3. Return spring
4. Cable guide
5. Lever
6. Cam boot
7. Cam
8. Lever stopper
9. Guide rod bolt
10. Bleed screw
11. Guide pin
12. Pin boot
13. Pad retainers
14. Caliper brocket
15. Circlip
16. Seat
17. Spring
18. Spring cage
19. Circlip
20. Piston
21. Piston seal
22. Piston boot

LJGE004B

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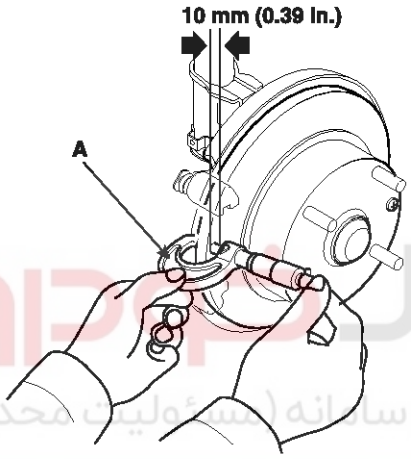
INSPECTION

REAR BRAKE DISC THICKNESS CHECK

1. Remove all rust and contamination from the disc surface, and then measure the disc thickness at 4 positions at least.

Rear brake disc thickness
Standard value : 10.0 mm (0.39 in.)
Limit : 8.0 mm (0.315 in.)

2. Thickness variation should not exceed 0.005mm (0.0002 in.) (circumference) and 0.05mm (0.0020 in.) (radius) at any directions.
3. If wear exceeds the limit, replace the discs and pad assembly for left and right of the vehicle.

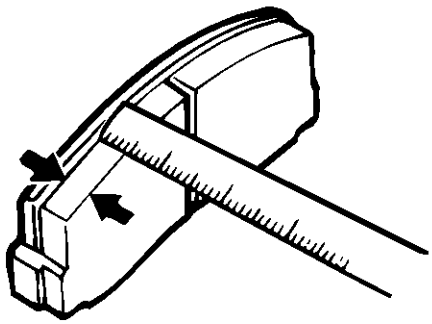


EJKE605B

REAR BRAKE PAD CHECK

1. Check the pad wear. Measure the pad thickness and replace it. If it is less than the specified value.

Pad thickness
Standard value : 9.0 mm (0.35 in.)
Service limit : 2.0 mm (0.0787 in.)



LJAC022A

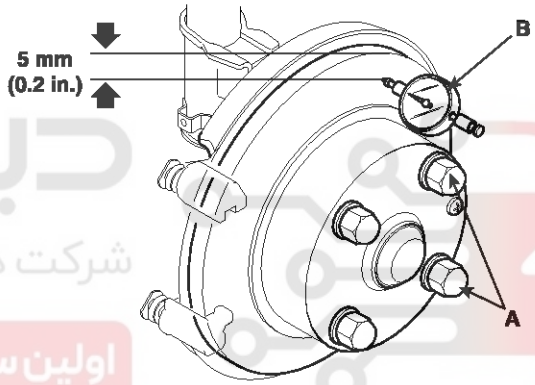
2. Check that grease is applied, and the pad and backing metal are not damaged.

REAR BRAKE DISC RUN OUT CHECK

1. Place a dial gauge about 5mm (0.2 in.) from the outer circumference of the brake disc, and measure the run out of the disc.

Brake disc run out
Limit : 0.03 mm (0.0012 in.) or less

2. If the run out of the brake disc exceeds the limit specification, replace the disc, and then measure the run out again.
3. If the run out does not exceed the limit specification, install the brake disc after turning it 180° and then check the run out of the brake disc again.
4. If the run out cannot be corrected by changing the position of the brake disc, replace the brake disc.



LJGE001H

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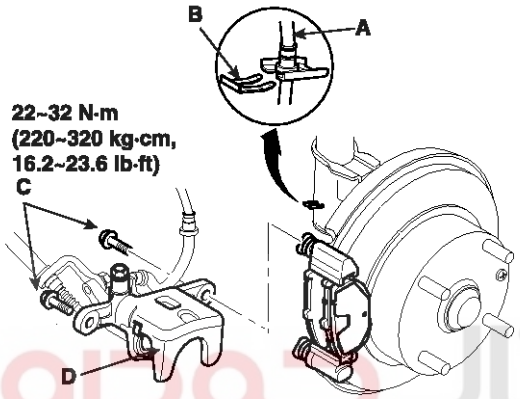
REMOVAL

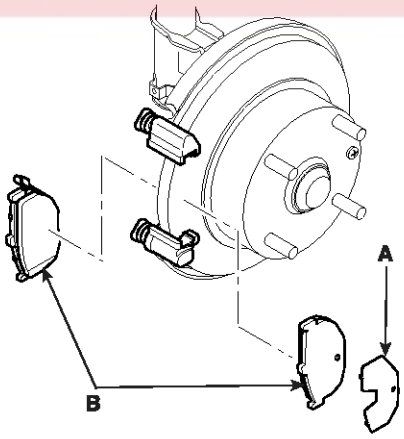
1. Raise the rear of the vehicle and make sure it is securely supported. Remove the rear wheel.
2. Release the parking brake.
3. Remove the brake hose (A) from the suspension arm by removing the brake hose clip (B).
4. Thoroughly clean the outside of the caliper to prevent dust and dirt from entering inside.

   Support the caliper with a piece of wire so that it does not hang from the brake hose.



EJKE600A

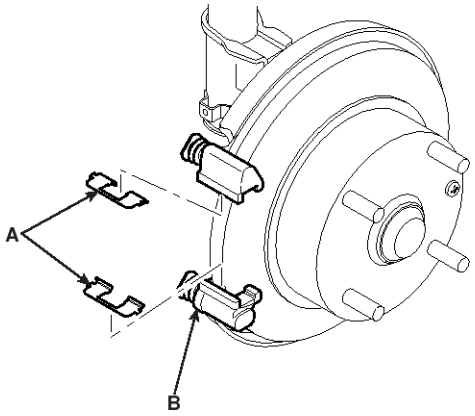
5. Remove the two guide rods (C) and caliper (D) from the bracket.
6. Remove the pad shim (A) and brake pads (B).



EJKE600B

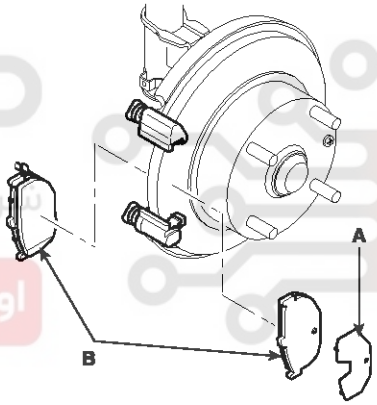
INSTALLATION

1. Install the pad springs(A) to the carrier(B).



EJKE600D

2. Check the foreign material at the pad shim (A) and the back of the pads (B).



AJGE019D

3. Contaminated brake discs or pads reduce stopping ability. Keep grease off the discs and pads.
4. Install the brake pads (B) and pad shim (A) on the caliper bracket. Install the inner pad with its wear indicator (C) facing down ward.

   If you are reusing the pads, always reinstall the brake pads in their original positions to prevent a momentary loss of braking efficiency.

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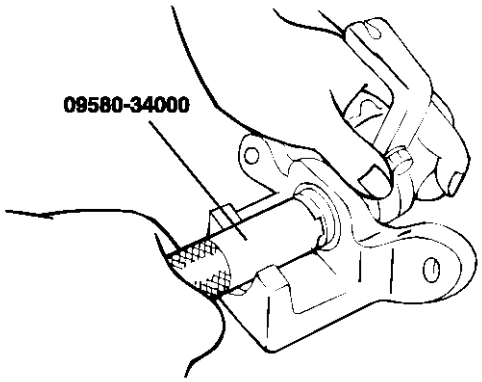
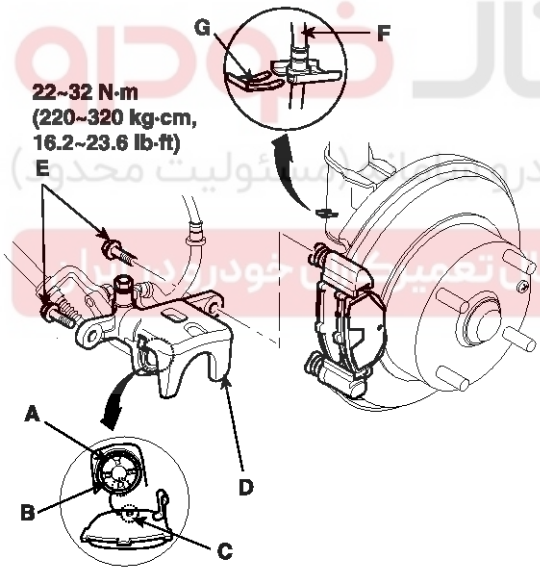
5. Rotate the caliper piston (A) clockwise into the cylinder, the align the cutout (B) in the piston with the tab (C) on the inner pad by turning the piston back. Lubricate the boot with rubber grease to avoid twisting the piston boot. If the piston boot is twisted, back it out so it is positioned properly.



EJKB037B



EJKE600F

6. Install the brake caliper (D).
7. Install and torque the guide rods (E) to proper specification.
8. Install the brake hose (F) onto the suspension arm with the brake hose clip (G).
9. After installation, check for leaks at hose and line joints and connections, and retighten if necessary.
10. Depress the brake pedal several times to make sure the brakes work, then test-drive.

NOTICE

Engagement of the brake may require a greater pedal stroke immediately after the brake pads have been replaced as a set.Several applications of the brake pedal will restore the normal pedal stroke.

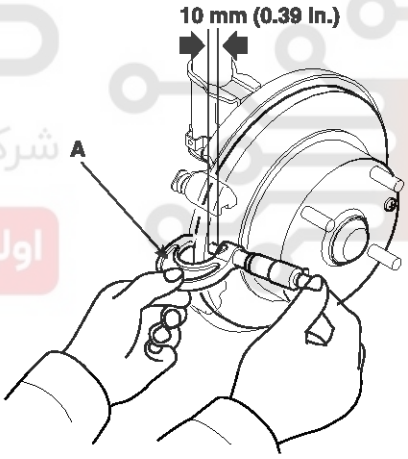
INSPECTION

REAR BRAKE DISC THICKNESS CHECK

1. Remove all rust and contamination from the disc surface, and then measure the disc thickness at 4 positions at least.

Rear brake disc thickness
Standard value : 10.0 mm (0.39 in.)
Limit : 8.0 mm (0.315 in.)

2. Thickness variation should not exceed 0.005mm (0.0002 in.) (circumference) and 0.05mm (0.0020 in.) (radius) at any directions.
3. If wear exceeds the limit, replace the discs and pad assembly for left and right of the vehicle.



EJKE605B

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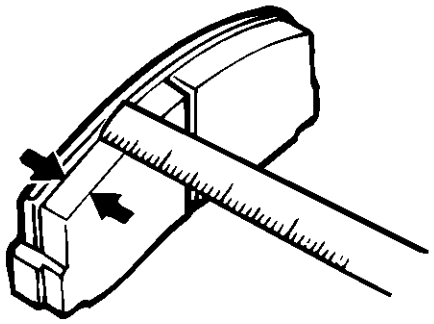
REAR BRAKE PAD CHECK

1. Check the pad wear. Measure the pad thickness and replace it. If it is less than the specified value.

Pad thickness
Standard value : 9.0 mm (0.35 in.)
Service limit : 2.0 mm (0.0787 in.)



LJAC022A

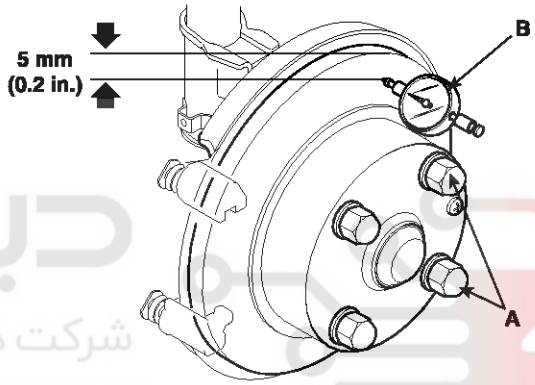
2. Check that grease is applied, and the pad and backing metal are not damaged.

REAR BRAKE DISC RUN OUT CHECK

1. Place a dial gauge about 5mm (0.2 in.) from the outer circumference of the brake disc, and measure the run out of the disc.

Brake disc run out
Limit : 0.03 mm (0.0012 in.) or less

2. If the run out of the brake disc exceeds the limit specification, replace the disc, and then measure the run out again.
3. If the run out does not exceed the limit specification, install the brake disc after turning it 180° and then check the run out of the brake disc again.
4. If the run out cannot be corrected by changing the position of the brake disc, replace the brake disc.



LJGE001H

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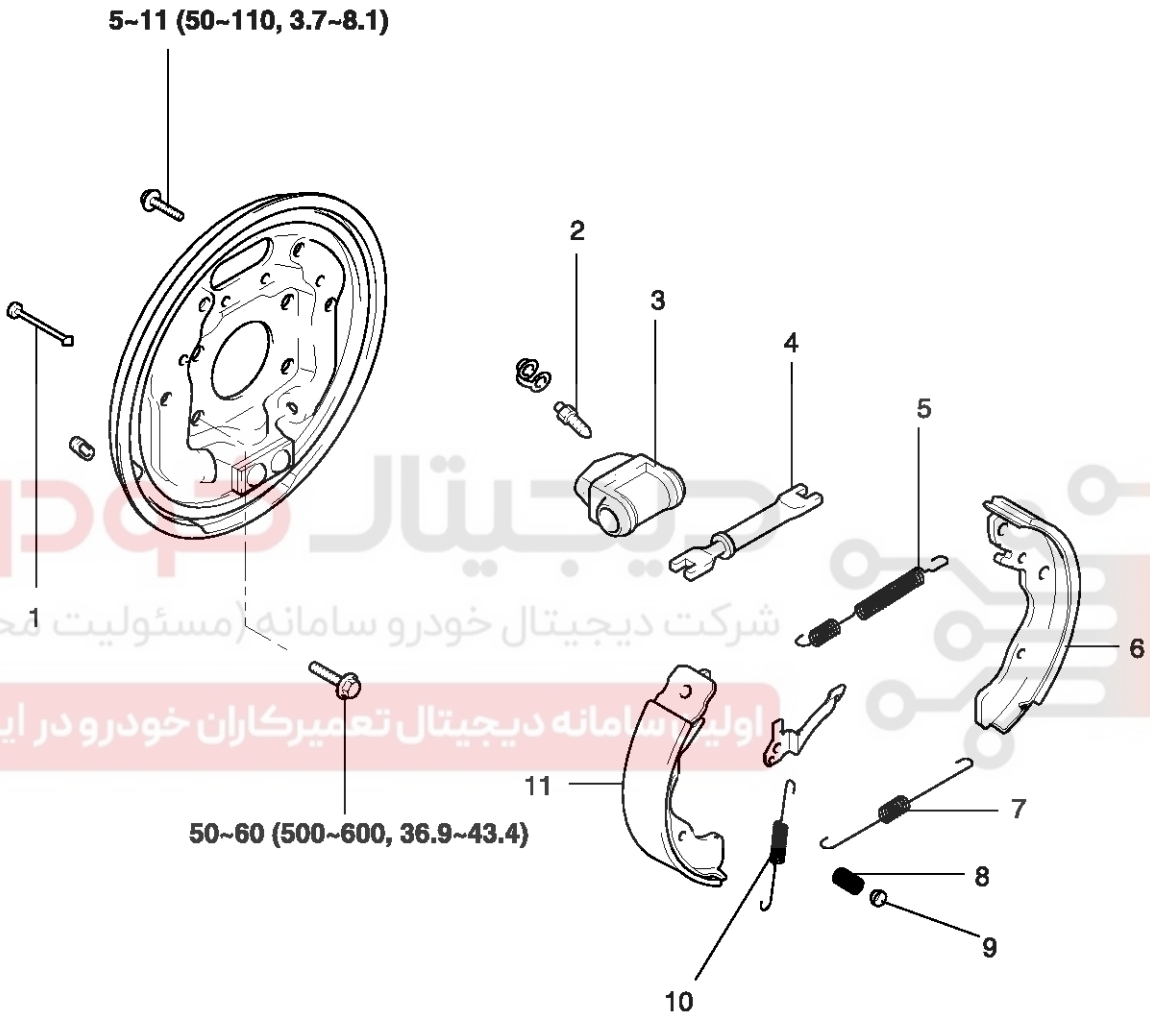
Rear Drum Brake

COMPONENTS



TORQUE : N·m (kg·cm, lb·ft)

1. Shoe hold down pin
2. Bleed screw
3. Wheel cylinder
4. Adjuster
5. Upper return spring
6. Shoe
7. Lower return spring
8. Shoe hold down spring
9. Shoe hold down washer
10. Self-adjuster spring
11. Shoe

LJGE001F

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INSPECTION

CAUTION

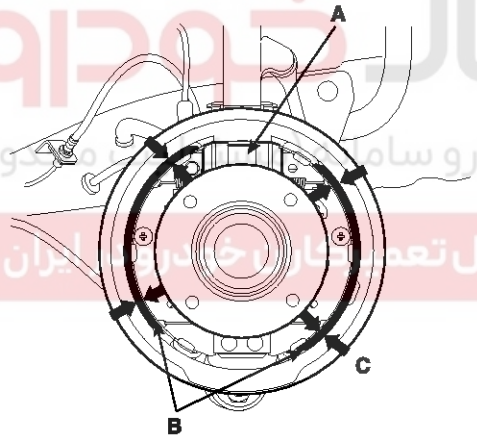
Frequent inhalation of brake pad dust, regardless of material composition, could be hazardous to your health.

- **Avoid breathing dust particles.**
- **Never use an air hose or brush to clean brake assemblies.**

NOTICE

- *Contaminated brake linings or drums reduce stopping ability.*
- *Block the front wheels before jacking up the rear of the vehicle.*

1. Raise the rear of the vehicle, and make sure it is securely supported.
2. Release the parking brake, and remove the rear brake drum.
3. Check the wheel cylinder (A) for leakage.



EJKE800A

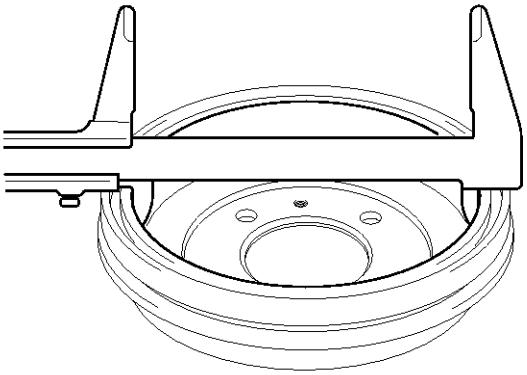
4. Check the brake linings (B) for cracking, glazing, wear, and contamination.
5. Measure the brake lining thickness (C).

   Measurement does not include brake shoe thickness.

Brake lining thickness
Standard : 4.5 mm (0.177 in.)
Service limit : 1.0 mm (0.039 in.)

6. If the brake lining thickness is less than the service limit, replace the brake shoes as a set.
7. Check the bearings in the hub unit for smooth operation. If it requires servicing, replace it.
8. Measure the inside diameter of the brake drum with inside vernier calipers.

Drum inside diameter:
Standard : 203.2 mm (8.0 in.)
Service limit : 205.2 mm (8.079 in.)



EJKE800B

9. If the inside diameter of the brake drum is more than the service limit, replace the brake drum.
10. Check the brake drum for scoring, grooves, and cracks.

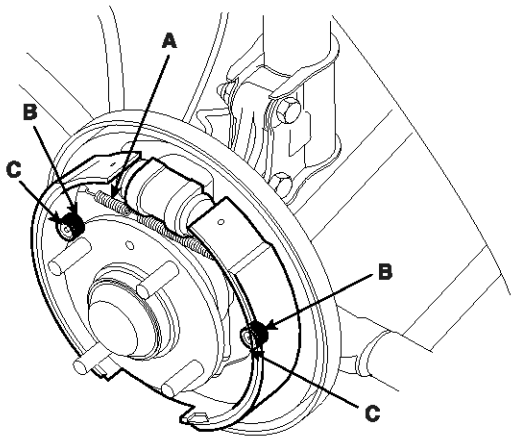
REMOVAL

CAUTION

Frequent inhalation of brake pad dust, regardless of material composition, could be hazardous to your health.

- **Avoid breathing dust particles.**
- **Never use an air hose or brush to clean brake assemblies.**

1. Remove the shoe hole down pins (B) by pushing the shoe hole down washer (C) and turning them.
2. Disengage the upper return spring (A).



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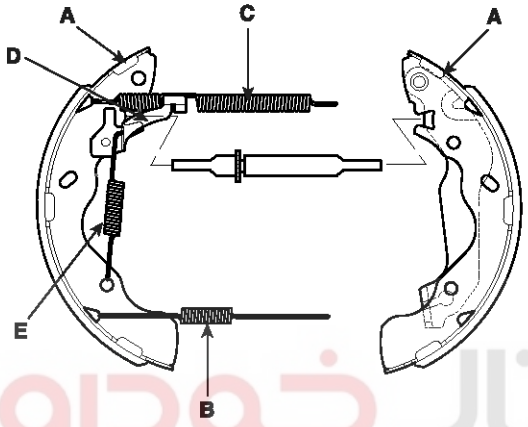
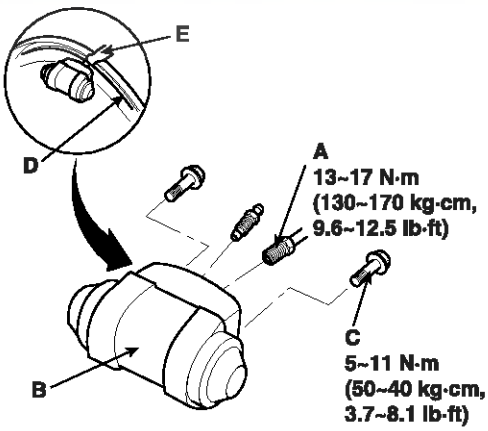
EJKE803A

3. Lower the brake shoe assembly (A), and remove the lower return spring (B). Make sure not to damage the dust cover on the wheel cylinder.
4. Disconnect the parking brake cable from the parking brake lever.
5. Remove the brake shoe assembly.
6. Remove the upper return spring (C), self-adjuster lever (D) and self-adjuster spring (E), and separate the brake shoes.



EJKE803B

7. Disconnect the brake line (A) from the wheel cylinder (B).
8. Remove the bolt (C) and the wheel cylinder from the backing plate.



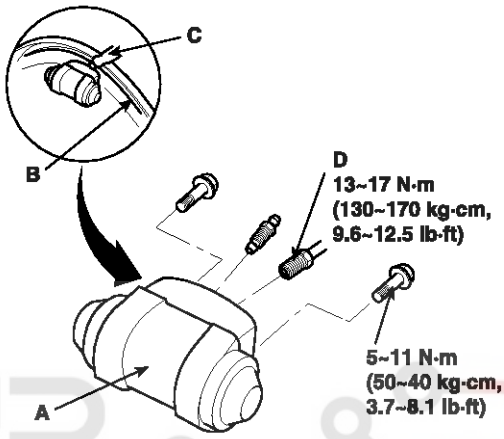
LJGE017A

INSTALLATION

NOTICE

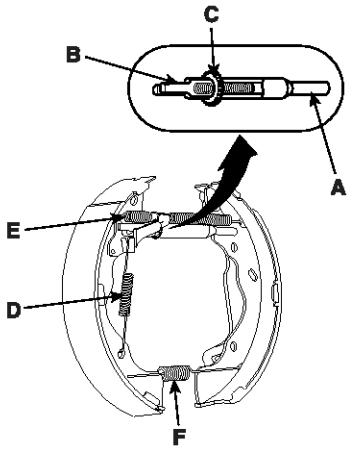
- *Do not spill brake fluid on the vehicle: it may damage the paint; if brake fluid does contact the paint. Wash it off immediately with water.*
- *To prevent spills, cover the hose joints with rags or shop towels.*
- *Use only a genuine wheel cylinder special bolt.*

1. Apply sealant (C) between the wheel cylinder (A) and backing plate (B), and install the wheel cylinder.



LJGE017B

2. Connect the brake tubes (D) to the wheel cylinder.
3. Connect the parking brake cable to the parking brake lever.
4. Clean the threaded portions of adjuster sleeve (A) and push rod female (B). Coat the threads of the adjuster assembly with grease. To shorten the clevises, turn the adjuster bolt (C).



EJKE803C

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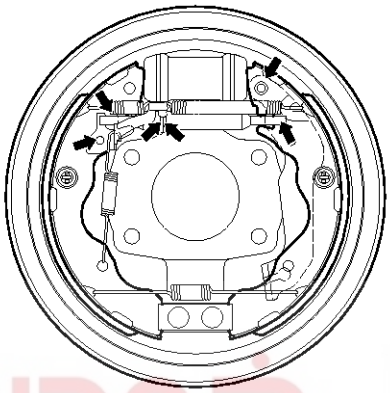
5. Hook the self-adjuster spring (D) to the adjuster lever first, then to the brake shoe.
6. Install the adjuster assembly and upper return spring (E), noting the installation direction. Be careful not to damage the wheel cylinder dust covers.
7. Install the lower return spring (F).
8. Apply brake cylinder grease or equivalent rubber grease to the sliding surfaces shown. Wipe off any excess. Don't get grease on the brake linings.

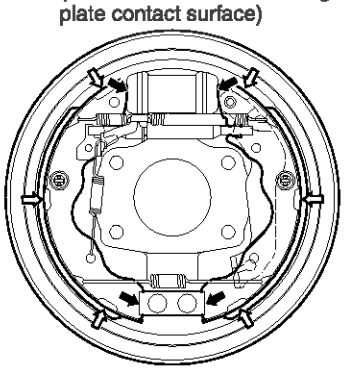
➡ **Sliding surface**



LJGE017C

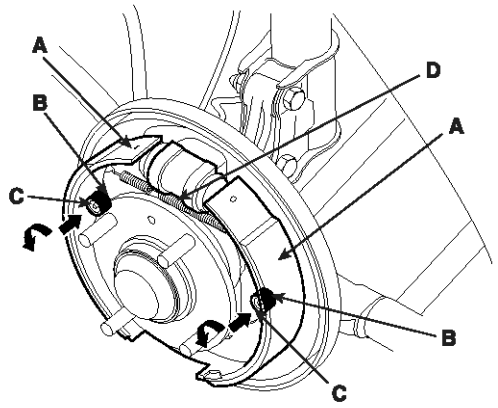
9. Apply brake cylinder grease or equivalent rubber grease to the brake shoe ends and opposite edges of the shoes shown. Wipe off any excess. Don't get grease on the brake linings.

➡ **Opposite edge of the shoe**
⇨ **Brake shoe ends**
(shoe side ends and backing plate contact surface)



LJGE017D

10. Install the brake shoes (A) onto the backing plate. Be careful not to damage the wheel cylinder dust covers.
11. Install the shoe hole down pins (B) and the shoe hole down washers (C).



EJKE803F

12. Hook the upper return spring (D).
13. Install the brake drum.
14. If the wheel cylinder has been removed, bleed the brake system.
15. Depress the brake pedal several times to set the self-adjusting brake.
16. Adjust the parking brake.

INSPECTION

⚠CAUTION

Frequent inhalation of brake pad dust, regardless of material composition, could be hazardous to your health.

- **Avoid breathing dust particles.**
- **Never use an air hose or brush to clean brake assemblies.**

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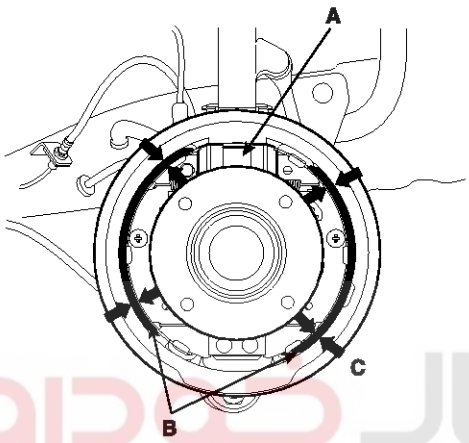
NOTICE

- *Contaminated brake linings or drums reduce stopping ability.*
- *Block the front wheels before jacking up the rear of the vehicle.*

1. Raise the rear of the vehicle, and make sure it is securely supported.
2. Release the parking brake, and remove the rear brake drum.
3. Check the wheel cylinder (A) for leakage.



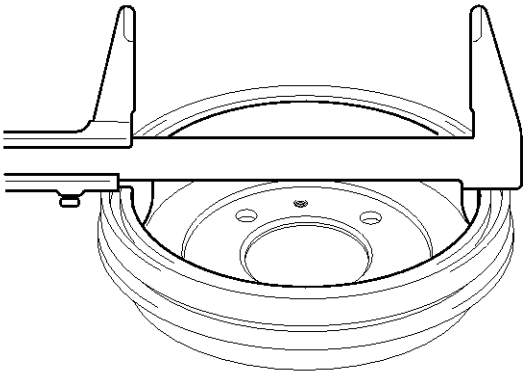
EJKE800A

4. Check the brake linings (B) for cracking, glazing, wear, and contamination.
5. Measure the brake lining thickness (C).
   Measurement does not include brake shoe thickness.

Brake lining thickness
Standard : 4.5 mm (0.177 in.)
Service limit : 1.0 mm (0.039 in.)

6. If the brake lining thickness is less than the service limit, replace the brake shoes as a set.
7. Check the bearings in the hub unit for smooth operation. If it requires servicing, replace it.
8. Measure the inside diameter of the brake drum with inside vernier calipers.

Drum inside diameter:
Standard : 203.2 mm (8.0 in.)
Service limit : 205.2 mm (8.079 in.)



EJKE800B

9. If the inside diameter of the brake drum is more than the service limit, replace the brake drum.
10. Check the brake drum for scoring, grooves, and cracks.

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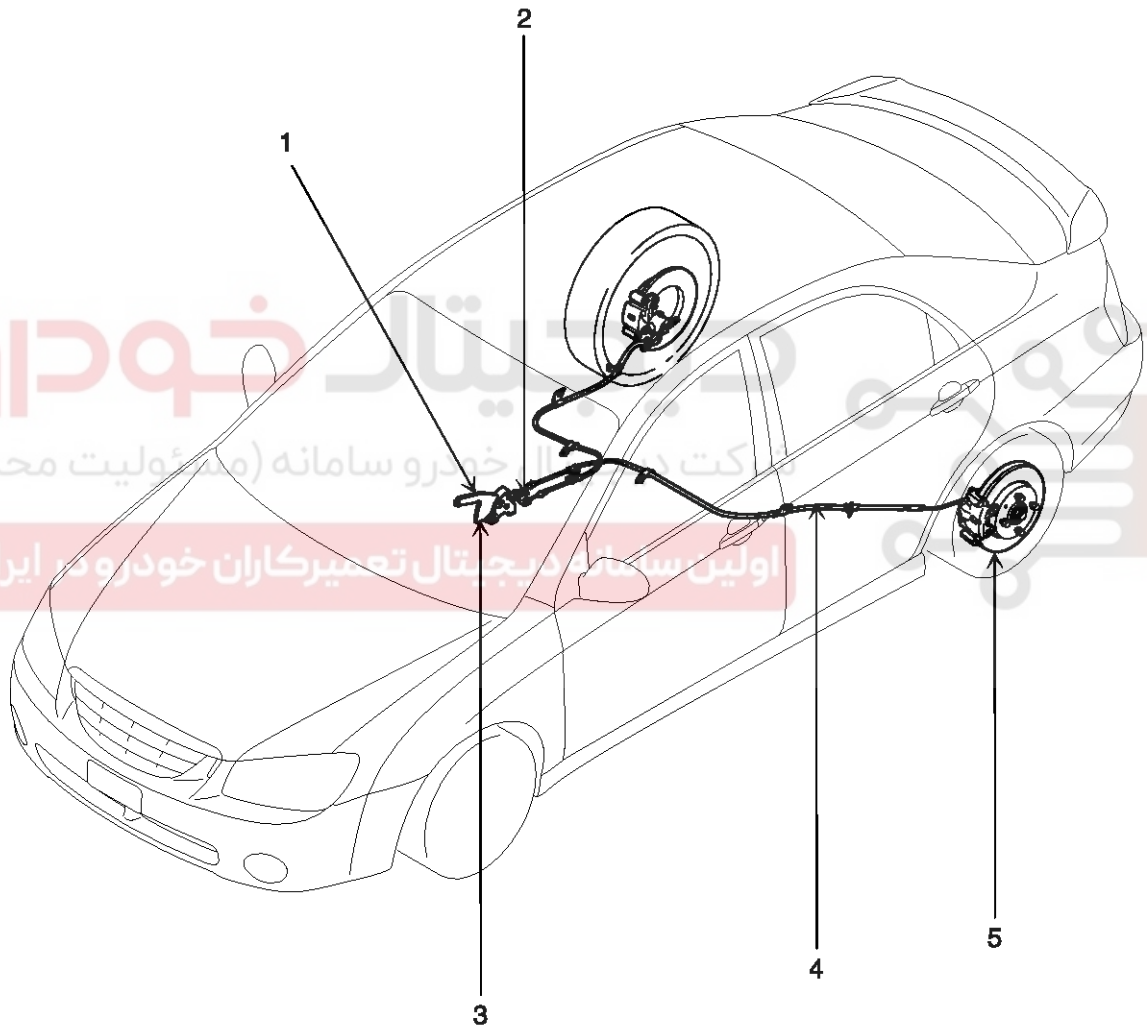
Parking Brake System

Parking Brake Assembly

COMPONENTS



1. Parking brake lever
2. Equalizer
3. Parking brake switch
4. Parking brake cable
5. Rear brake caliper

LJGE037A

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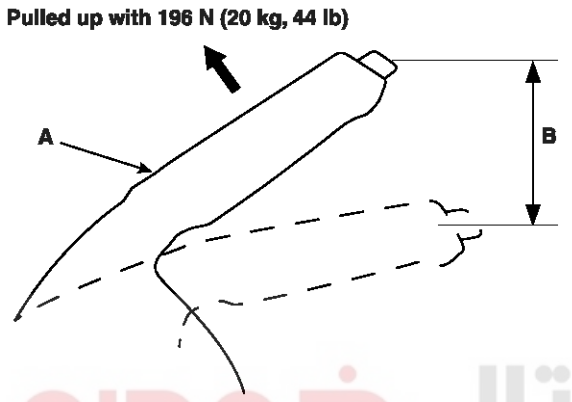
Parking brake check and adjustment

INSPECTION

1. Pull the parking brake lever (A) with 196 N (20 kg, 44lbf) force to fully apply the parking brake. The parking brake lever should be locked within the specified number of clicks (B).

Lever locked clicks:
Vehicle with rear disc brakes: 8~9
Vehicle with rear drum brakes: 8



EJKE002A

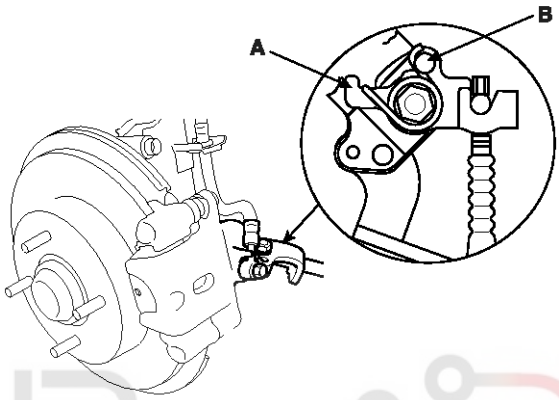
2. Adjust the parking brake if the lever clicks are out of specification.

ADJUSTMENT

NOTICE

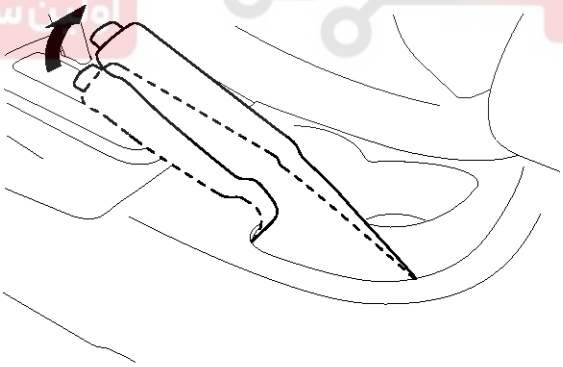
After rear brake caliper servicing, loosen the parking brake adjusting nut, start the engine and depress the brake pedalseveral times to set the self-adjusting brake before adjusting the parking brake.

1. Block the front wheels, then raise the rear of the vehicle and make sure it is securely supported.
2. Make sure the parking brake arm (A) on the rear brake caliper contacts the brake caliper pin (B).



EJKE002B

3. Pull the parking brake lever up one click.



EJKE002C

4. Remove the console.

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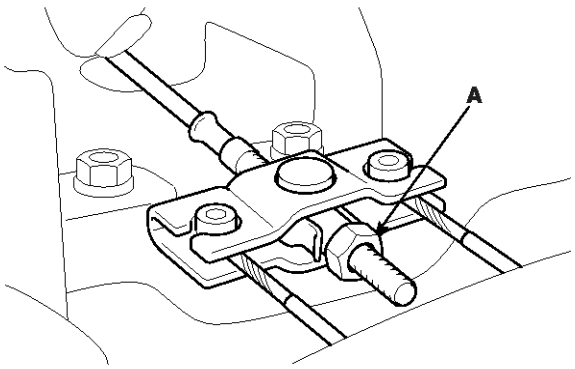
5. Tighten the adjusting nut (A) until the parking brakes drag slightly when the rear wheels are turned.



EJKE002D

6. Release the parking brake lever fully, and check that parking brakes do not drag when the rear wheels are turned. Readjust if necessary.
7. Make sure that the parking brakes are fully applied when the parking brake lever is pulled up fully.
8. Reinstall the console.

REMOVAL

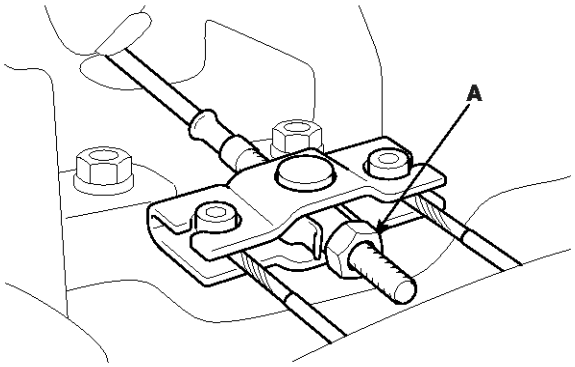
NOTICE

The parking brake cables must not be bent or distorted.

This will lead to stiff operation and premature failure.

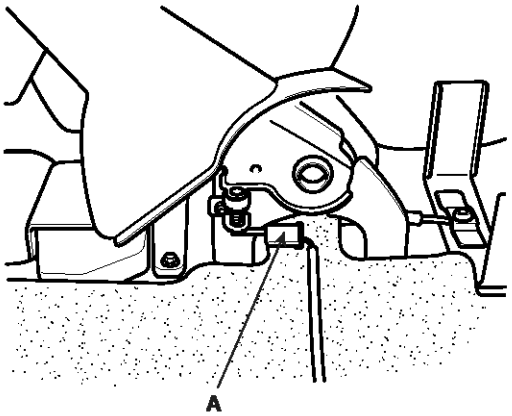
Rear drum brake

1. Remove the console.
2. Loosen the adjusting nut (A) and the parking brake cables.



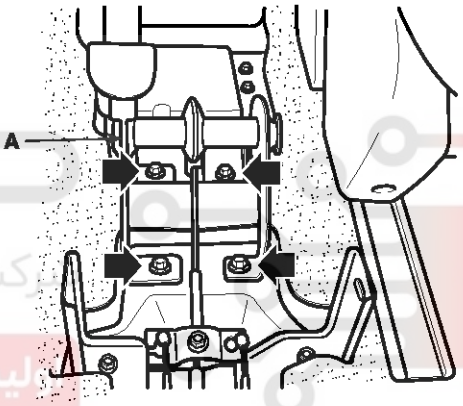
EJKE002D

3. Disconnect the connector(A) of parking brake switch.



AJGE038B

4. Remove the parking brake lever assembly(A).



AJGE038C

5. Remove the wheel and tire.
6. Remove the brake drum and the brake shoe (Refer to the rear drum brake).
7. Remove the parking brake cable from the brake shoe.

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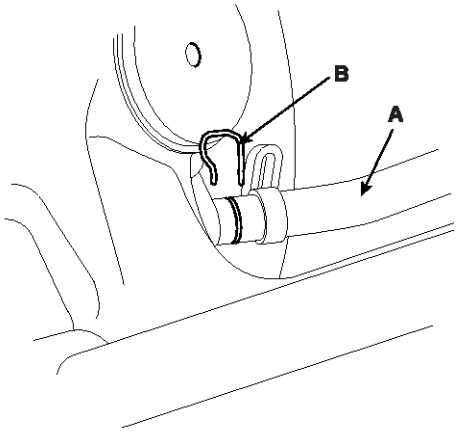
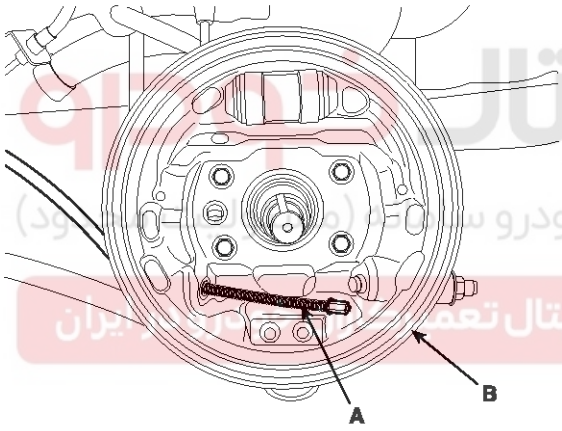
8. Remove the parking brake cable retaining (B), from the parking brake cable (A).



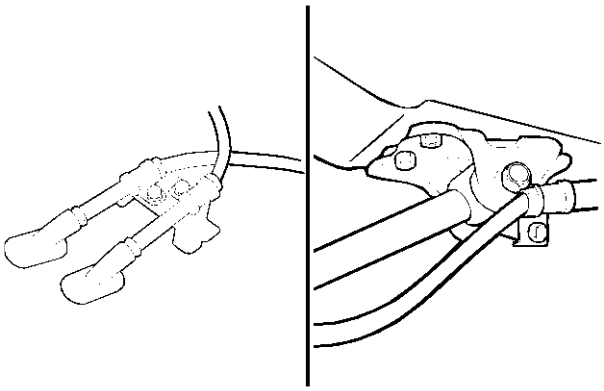
EJKE900B

9. Remove the parking brake cable (A) from the backing plate (B).



EJKE900C

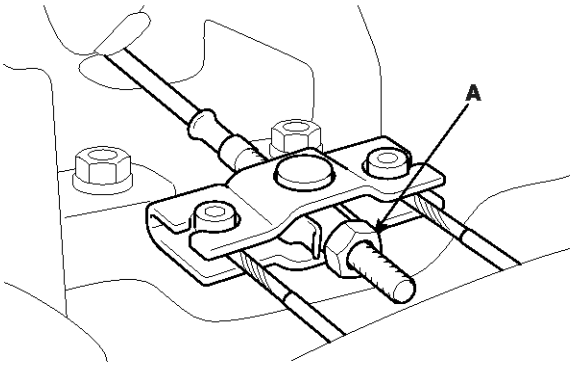
10. Remove the clamps of parking brake cables and then remove the parking brake cables.



EJKB039A

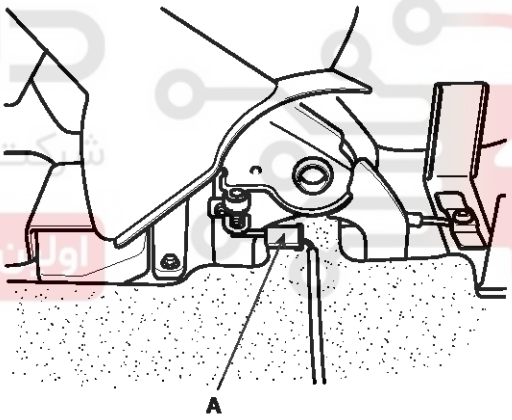
Rear disc brake

1. Remove the console.
2. Loosen the adjusting nut (A) and the parking brake cables.



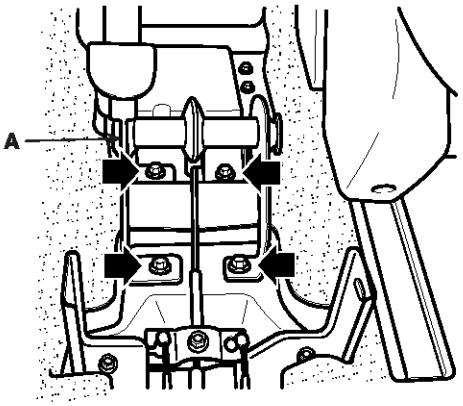
EJKE002D

3. Disconnect the connector(A) of parking brake switch.



AJGE038B

4. Remove the parking brake lever assembly(A).



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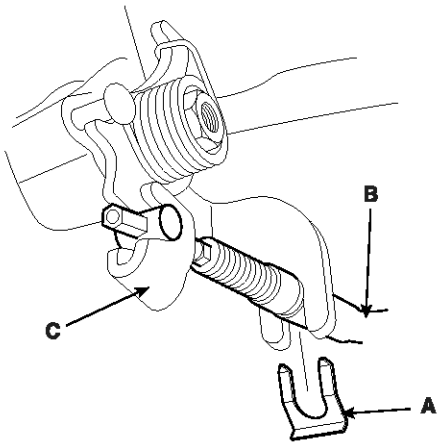
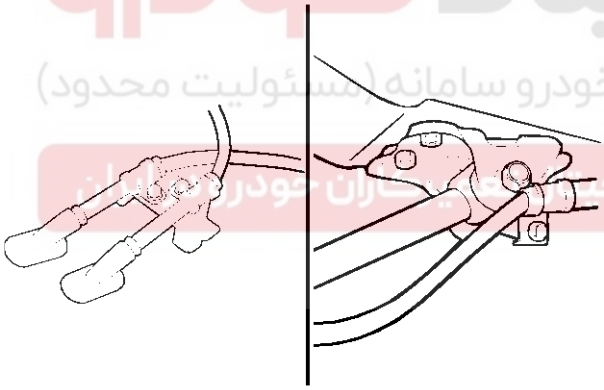
AJGE038C

5. Remove the parking cable clip (A) from the parking brake cable(B).
6. Disconnect the parking brake cable (B) from the lever (C).



EJKE900A

7. Remove the clamps of parking brake cables and then remove the parking brake cables.

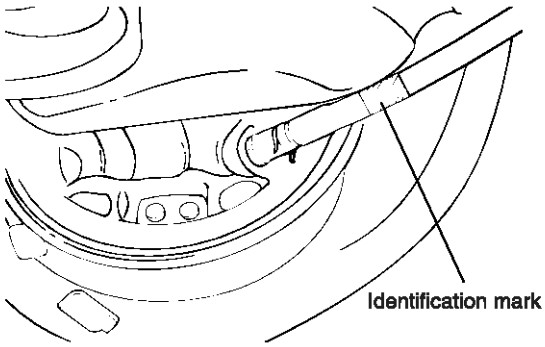


EJKB039A

INSTALLATION

1. Check the parking brake cables for an identification mark paint and install as appropriate on the left and right sides.

Identification color
Left side : Red
Right side : Yellow



LJGE038A

2. Install the removed parts in the reverse order of removal.
3. Apply a coating of the specified grease to each sliding parts of the ratchet plate or the ratchet pawl.

Specified grease :
Multi purpose grease SAE J310, NLGI No.2

4. After installing the cable adjuster, adjust the parking brake lever stroke (Refer to the parking brake check and adjustment).

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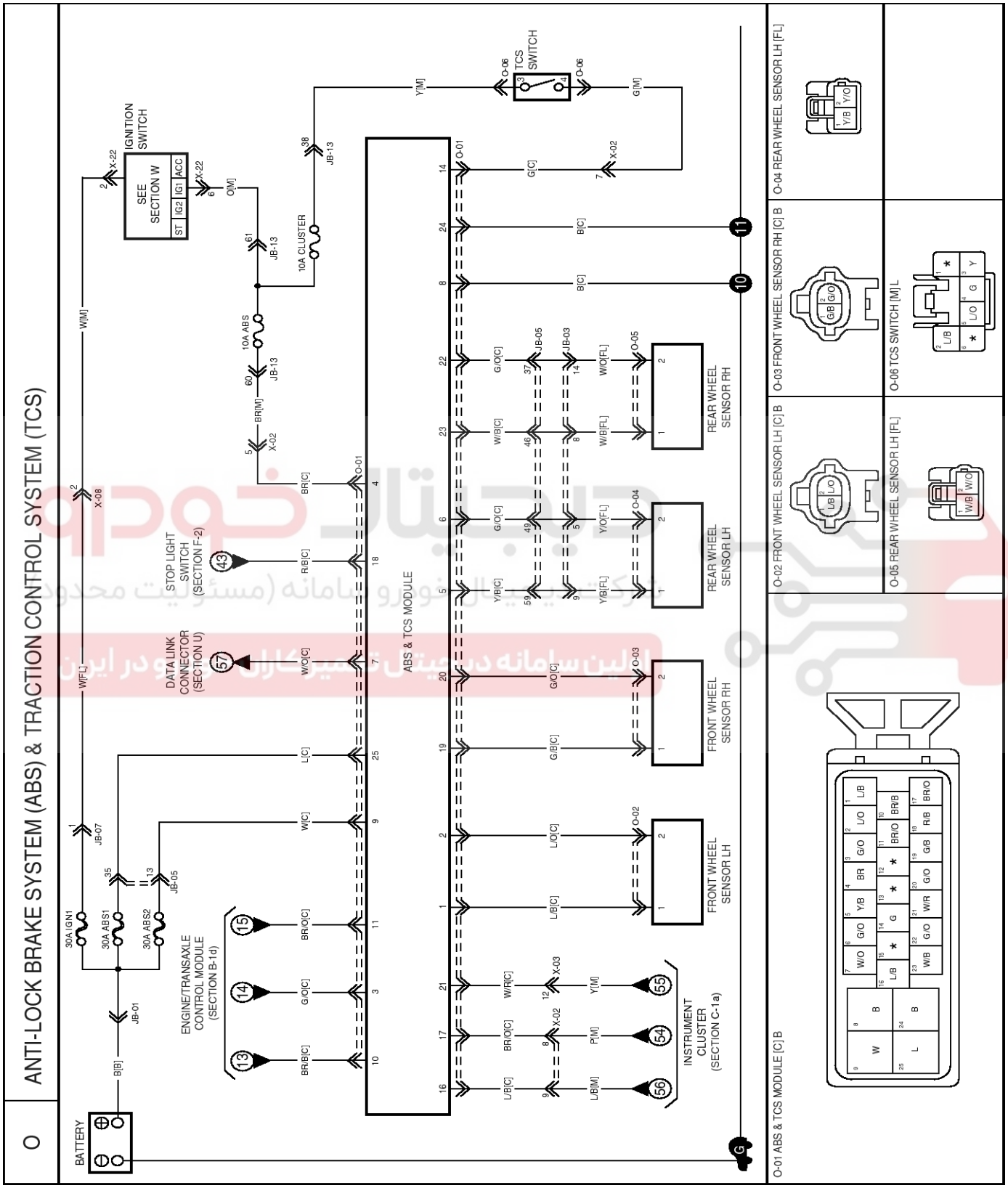
ABS(Anti-Lock Brake System)

CIRCUIT DIAGRAM



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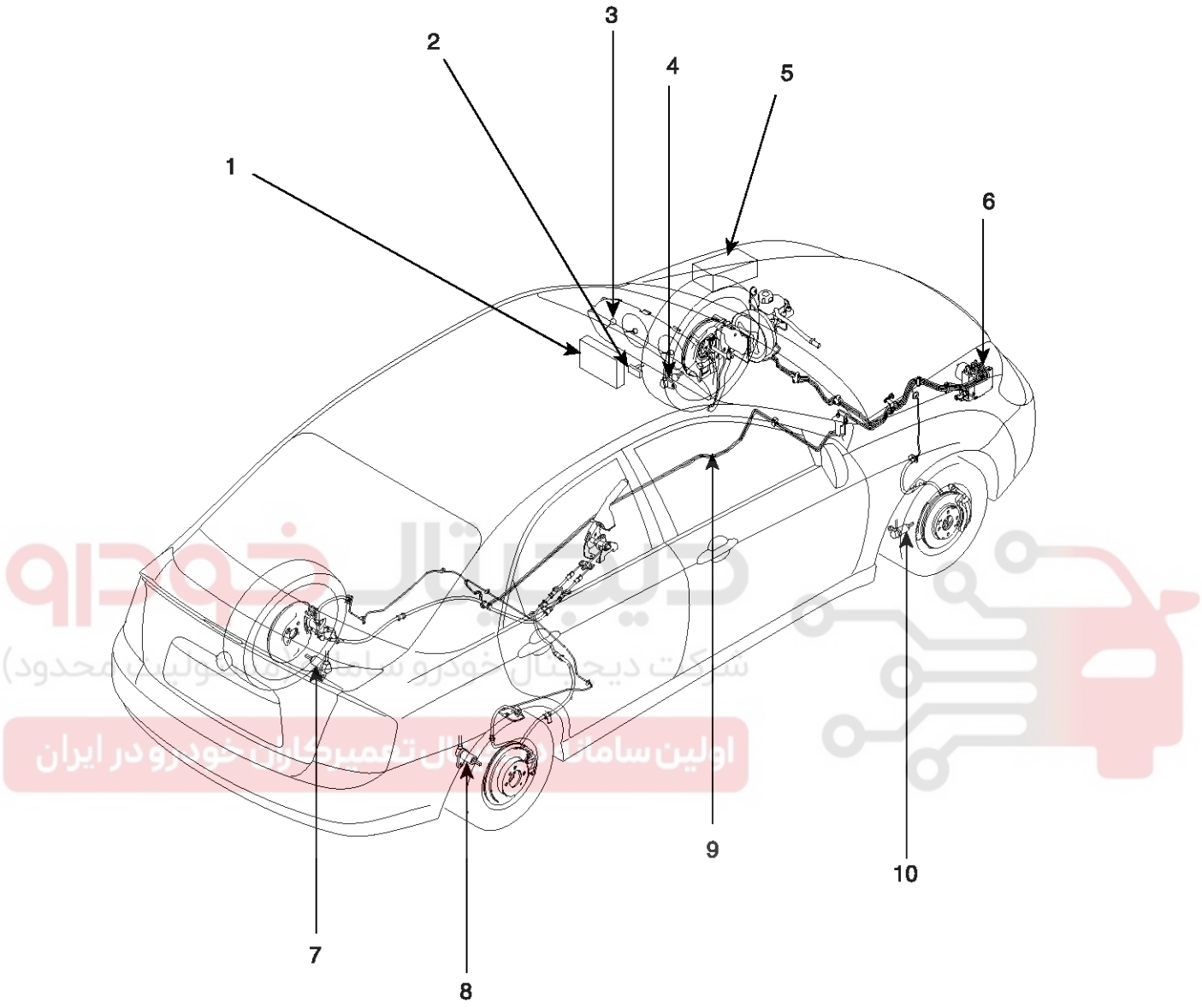
COMPONENTS



1. Passenger compartment junction block
2. Data link connector (16P)
3. Cluster
   - ABS indicator
4. Left-Front wheel speed sensor
5. Engine compartment junction box
6. ABS Control module (HECU)
7. Left-Rear wheel speed sensor
8. Right-Rear wheel speed sensor
9. Hydraulic lines
10. Right-Front wheel speed sensor

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DESCRIPTION

This specification applies to Hydraulic and Electronic Control Unit (HECU) of the Anti lock Braking System(ABS) and Traction Control System(TCS).

This HECU has the functions as follows:

- Input of signal from the wheel speed sensors attached to each wheel.
- Control of braking force and traction force.
- Fail-safe function.
- Self diagnosis function.
- Interface with the external diagnosis tester.

OPERATION

The HECU shall be put into operation by switching on the operating voltage (IGN).

On completion of the initialization phase, the HECU shall be ready for operation.

In the operating condition, the HECU shall be ready, within the specified limits (voltage and temperature), to process the signals offered by the various sensors and switches in accordance with the control algorithm defined by the software and to control the hydraulic and electrical actuators.

The HECU shall receive wheel speed signal from the four inductive wheel sensors.

The wheel signals are converted to square wave by the signal conditioning circuit and given as input to the µ-processor.

The sensor connections shall be monitored for short-circuit and interruption and then in the event of 2 sensor failures, the HECU shall shut down the system.

When one side of the valve coil is connected to the positive voltage that is provided through the valve relay and the other side is connected to the ground by the MOSFET, the solenoid valve goes into operation.

The electrical function of the valves is always monitored by the valve test pulse under normal operation conditions.

When overvoltage is detected(above 16V), the HECU switches off the valve relay and shuts down the system. When voltage is returned to operating range, the system goes back to the normal condition after the initialization phase.

In the event of undervoltage(below 10V), ABS control shall be inhibited and the warning lamp shall be turned on.When voltage is returned to operating range, the warning lamp is switched off and the HECU returns to normal operating mode.

The pump motor operates when the ABS is functioning.

The HECU performs a pump motor test at a speed of 20km/h once after turned the Ignition switch on. You may hear the motor operation at this time, but it is normal.

Malfunctions or failures detected by the HECU are encoded on the HECU, stored in a EEPROM and read out by diagnostic equipment (hi-scan pro) when the ignition switch is turned on.

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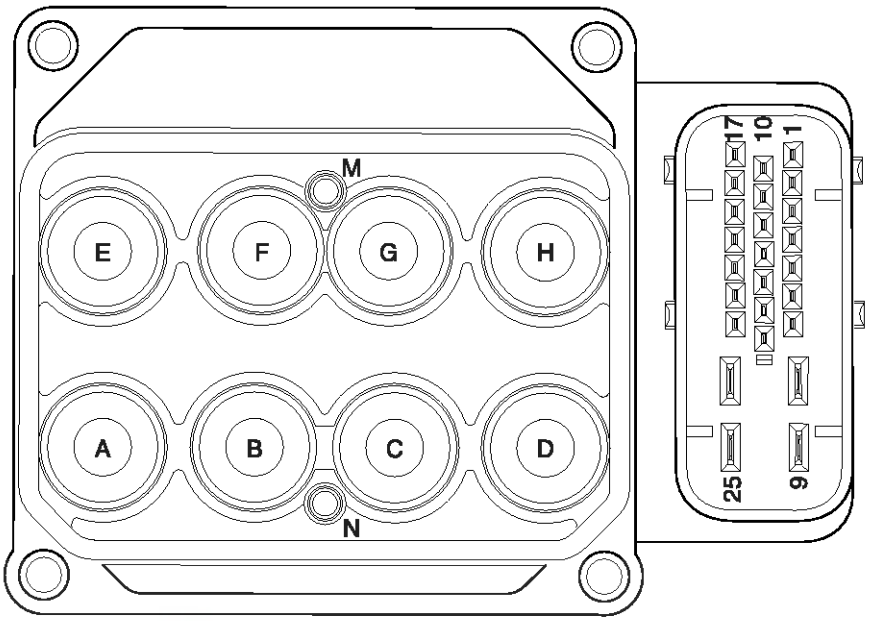
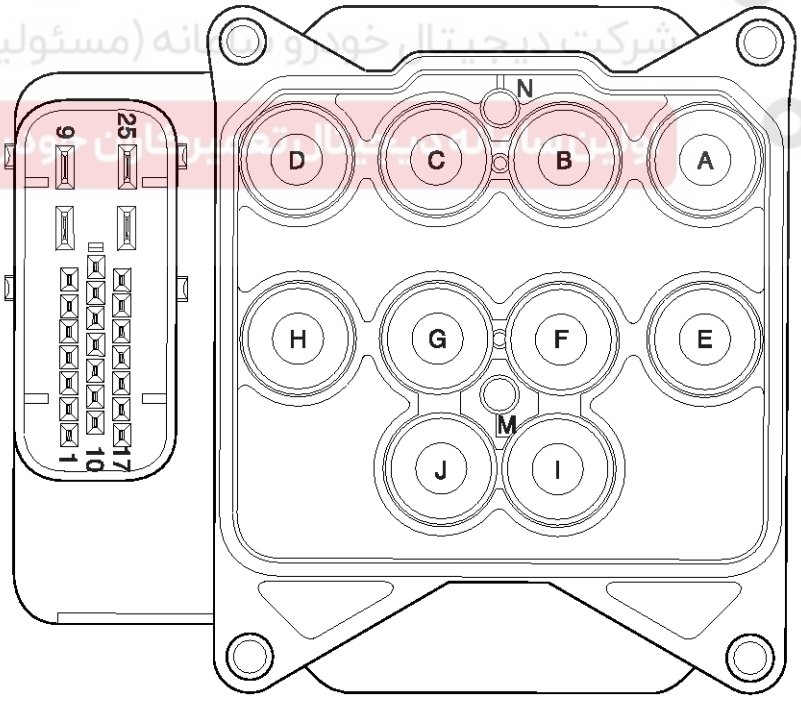
HECU EXTERNAL DIAGRAM



A : INLET VALVE (FR)
B : INLET VALVE (RL)
C : INLET VALVE (RR)
D : INLET VALVE (FL)
E : OUTLET VALVE (FR)
F : OUTLET VALVE (RL)
G : OUTLET VALVE (RR)
H : OUTLET VALVE (FL)
M : MOTOR(+)
N : MOTOR(GND)

[ABS ECU external diagram]



A : INLET VALVE (FR)
B : INLET VALVE (RL)
C : INLET VALVE (RR)
D : INLET VALVE (FL)
E : OUTLET VALVE (FR)
F : OUTLET VALVE (RL)
G : OUTLET VALVE (RR)
H : OUTLET VALVE (FL)
I : TRACTION VALVE (TCR)
J : TRACTION VALVE (TCL)
M : MOTOR(+)
N : MOTOR(GND)

[TCS ECU external diagram]

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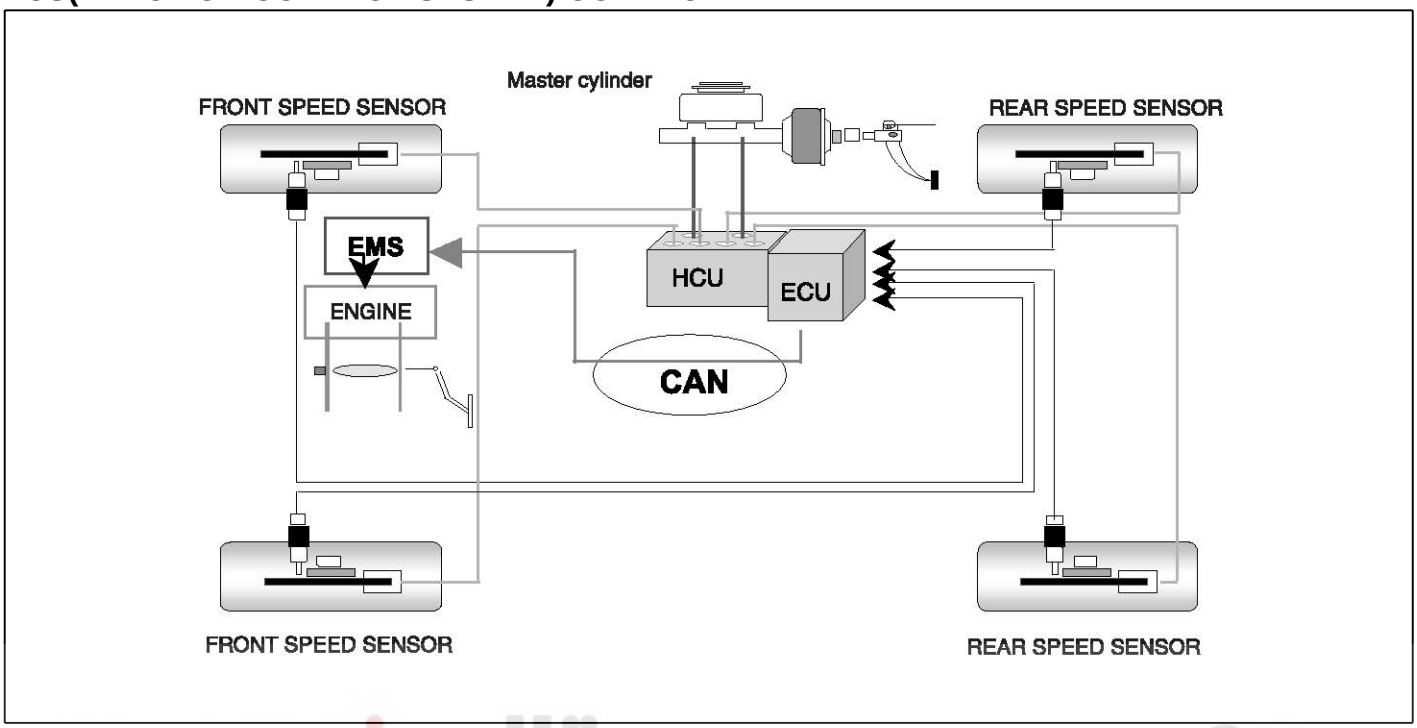
TCS(TRACTION CONTROL SYSTEM) CONTROL



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TRACTION CONTROL SYSTEM (TCS) FUNCTION

1. Main performance
   - Traction: Lower vibration and higher launchability, acceleration and climbability by slip control.
   - Cornering and passing: Stable cornering and passing.
   - Steering stability: Control traction force traverse vector prior to provide easy turning when turning the steering wheel.
2. General TCS features
   - Improved drivability. Minor operation of acceleration is not necessary in launching and acceleration on slippery road.
   - More stable cornering by stable acceleration on normal road condition.
   - TCS system will compare vehicle speed received from rear wheel speed sensor and driving wheel speed from front wheel speed sensor on slippery road condition, and provide optimum slipping rate of driving wheels.

FULL TRACTION CONTROL SYSTEM (FTCS)

1. The TCS control module (HECU) controls TCS control. It includes ABS control module.
2. HECU will compare signals from front (driving) and rear wheel speed sensors to detect driving wheels slip.
3. Upon detecting driving wheels slip, HECU will perform TCS control. The TCS control will include brake TCS (BTCS) control.
4. HECU will transmit engine torque reduction request, fuel cut cylinder number, and TCS control request signals in accordance with slip level to engine ECM and TCM through BUS line which will provide CAN communication for TCS control.
5. Engine ECM will perform fuel cut as requested by HECU and retard ignition timing as per engine torque reduction request signal.
6. TCM will hold shift position by TCS control time according to TCS operation signal. Then enhanced acceleration by kick-down will not occur.

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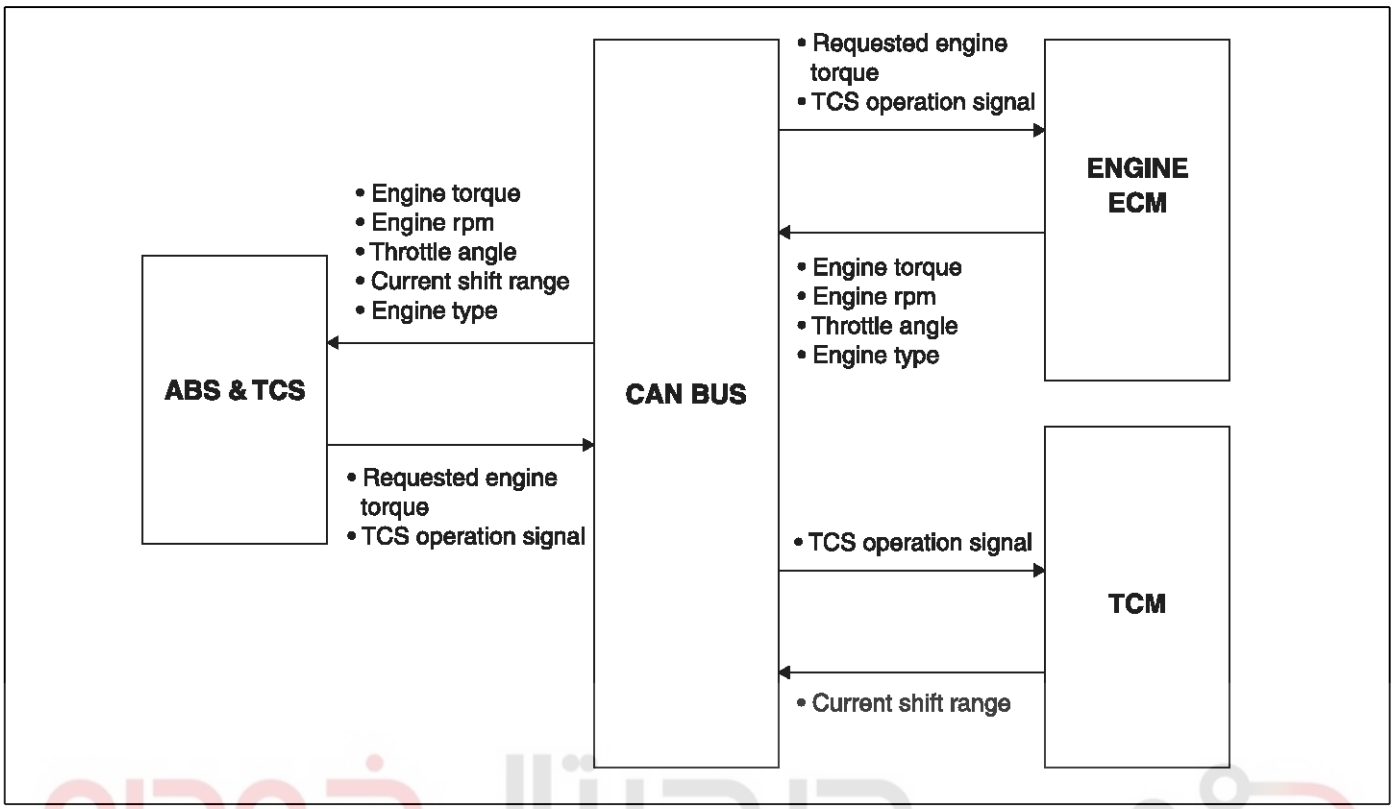

EJKD540A

BRAKE TRACTION CONTROL SYSTEM (BTCS)

1. On TCS control, only brake control will be performed. (engine and TCM control will not happen)
2. Controlled by motor pump output pressure.

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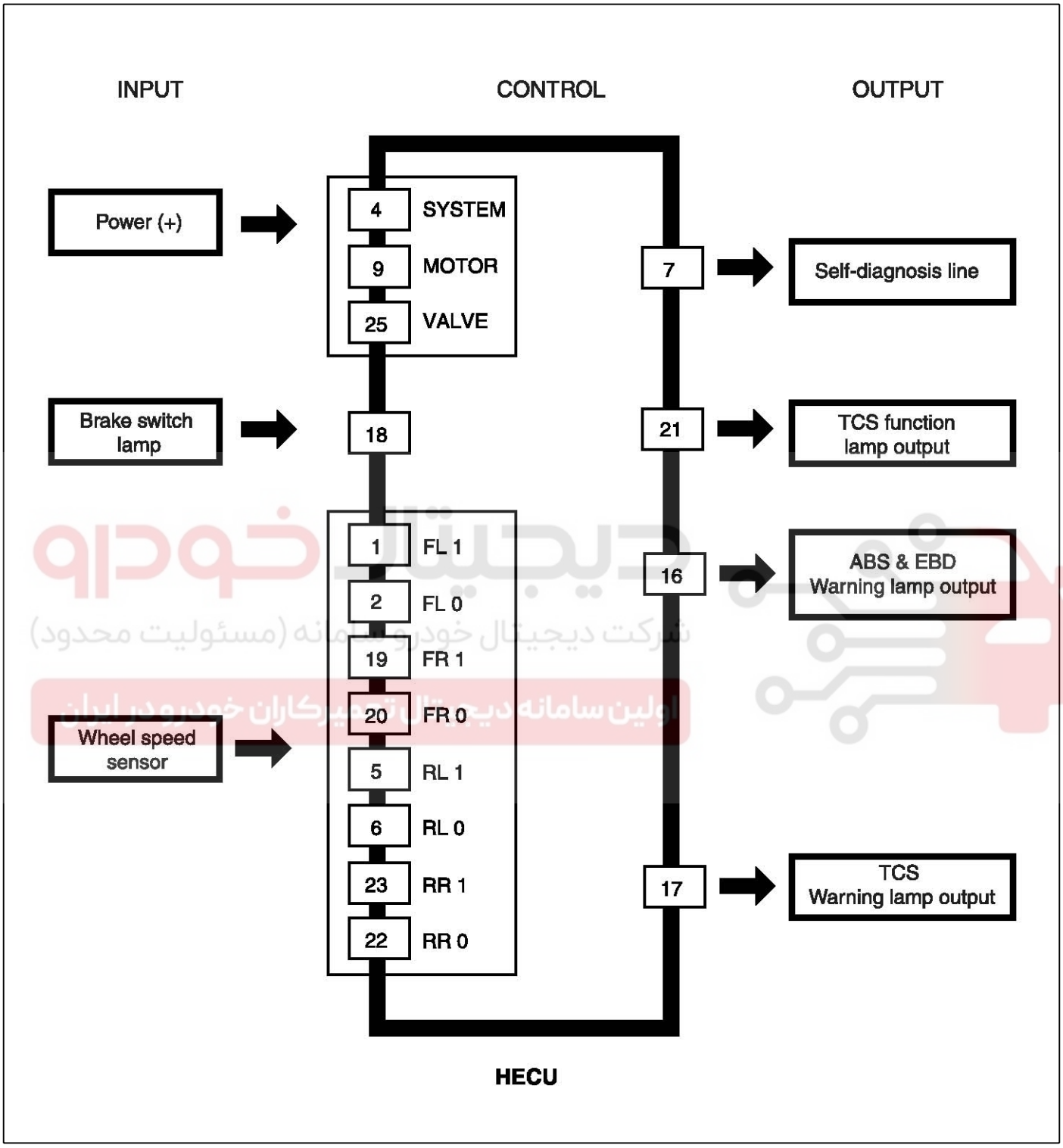
INPUT/OUTPUT BLOCK DIAGRAM

1. INPUT/OUTPUT DIAGRAM



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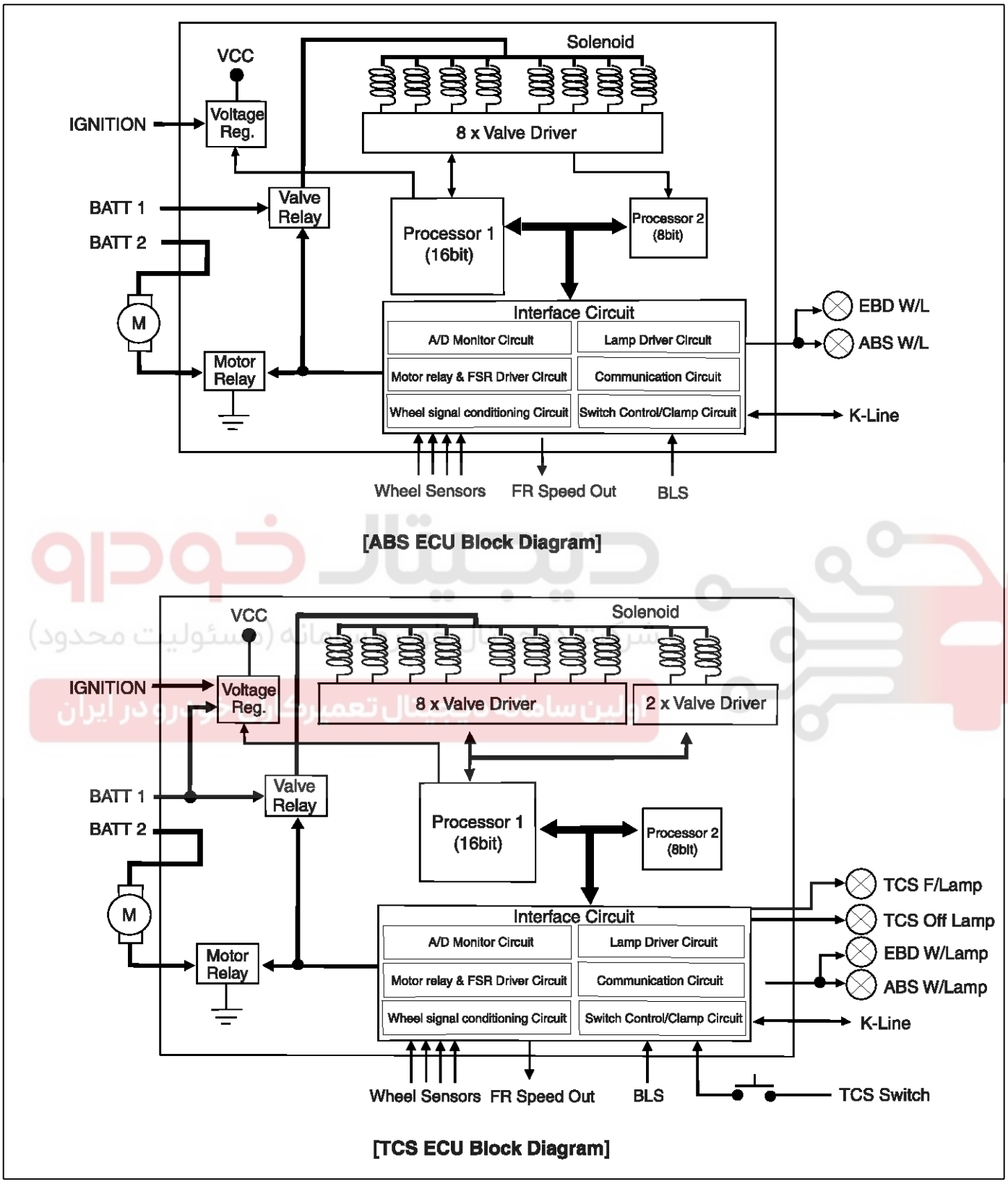
2. ABS ECU BLOCK DIAGRAM



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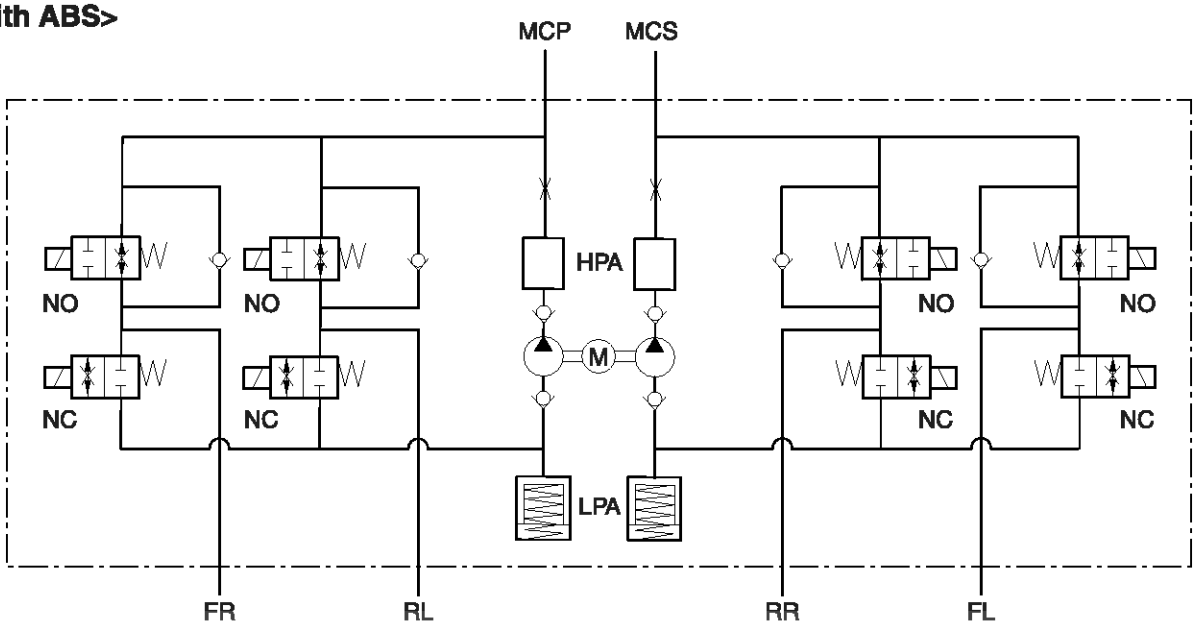
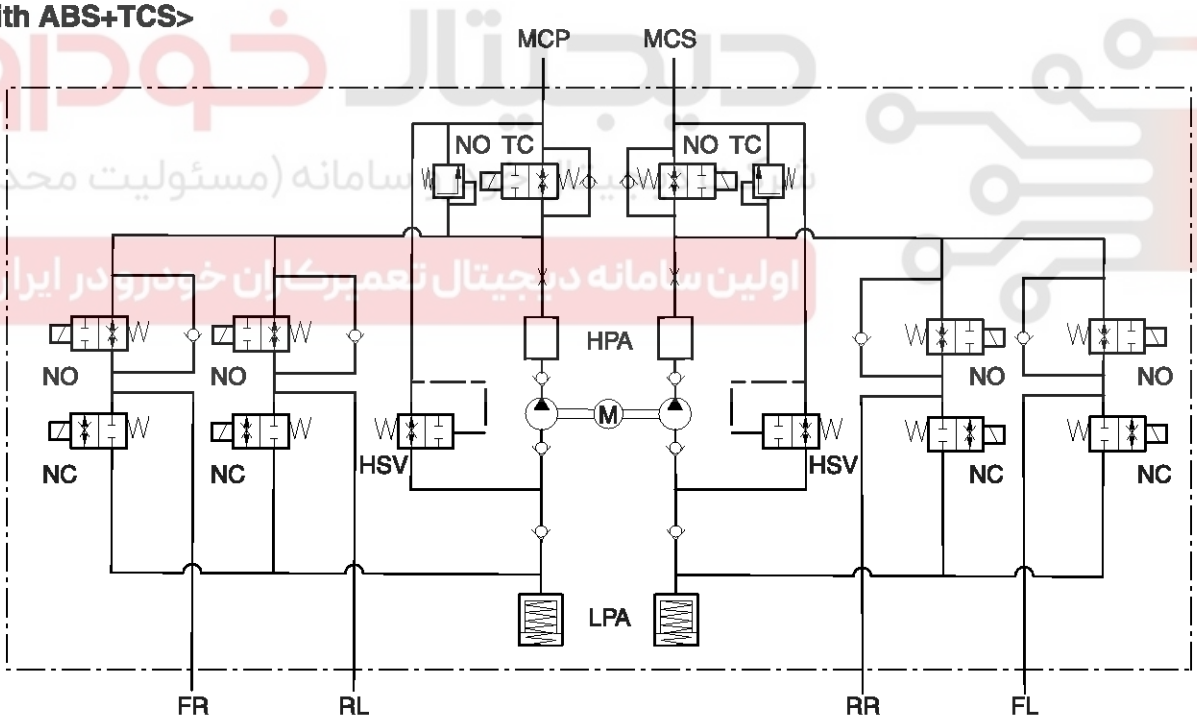
HYDRAULIC SYSTEM DIAGRAM

<With ABS>



<With ABS+TCS>



TCS : Traction Control System
MCP : Master Cylinder Primary
MCS : Master Cylinder Secondary
HPA : High Pressure Accumulator
LPA : Low Pressure Accumulator
M : Motor Pump
HSV : Hydraulic Shuttle Valve
TC : Traction Control valve
NO : Normal Open valve
NC : Normal Close valve

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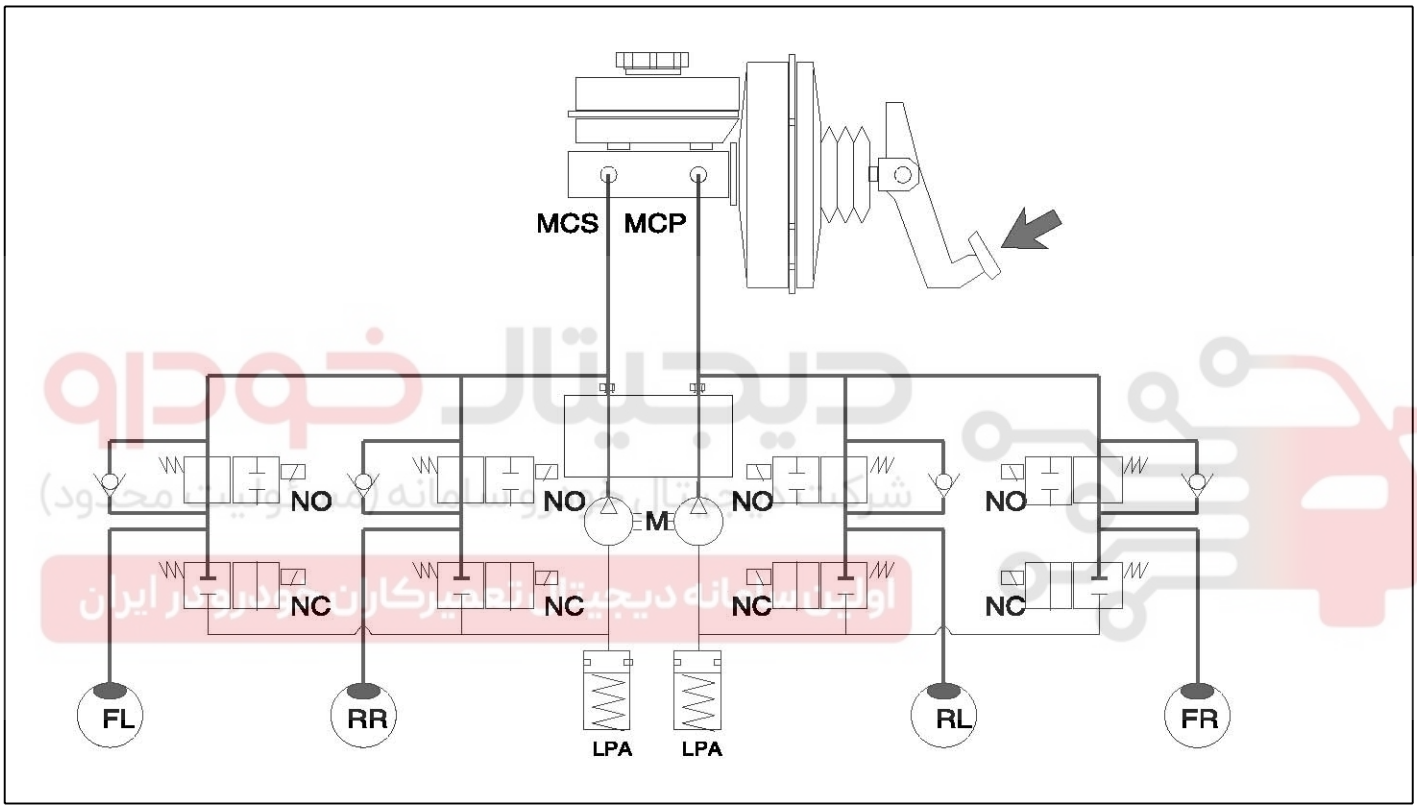
SYSTEM FUNCTION

ABS OPERATION

1. NORMAL BRAKING

Solenoid valve	State	Valve	Passage	Pump motor
IN (NO)	OFF	OPEN	Master cylinder ⇔ Wheel cylinder	OFF
OUT (NC)	OFF	CLOSE	Wheel cylinder ⇔ Reservoir	

Under the normal braking, voltage is not supplied to solenoid valve, inlet valve is opened and outlet valve is closed.
When the brake is depressed, brake fluid is supplied to the wheel cylinder via solenoid valve to activate the brake.
When the brake is released, brake fluid is back to the master cylinder via inlet valve and check valve.



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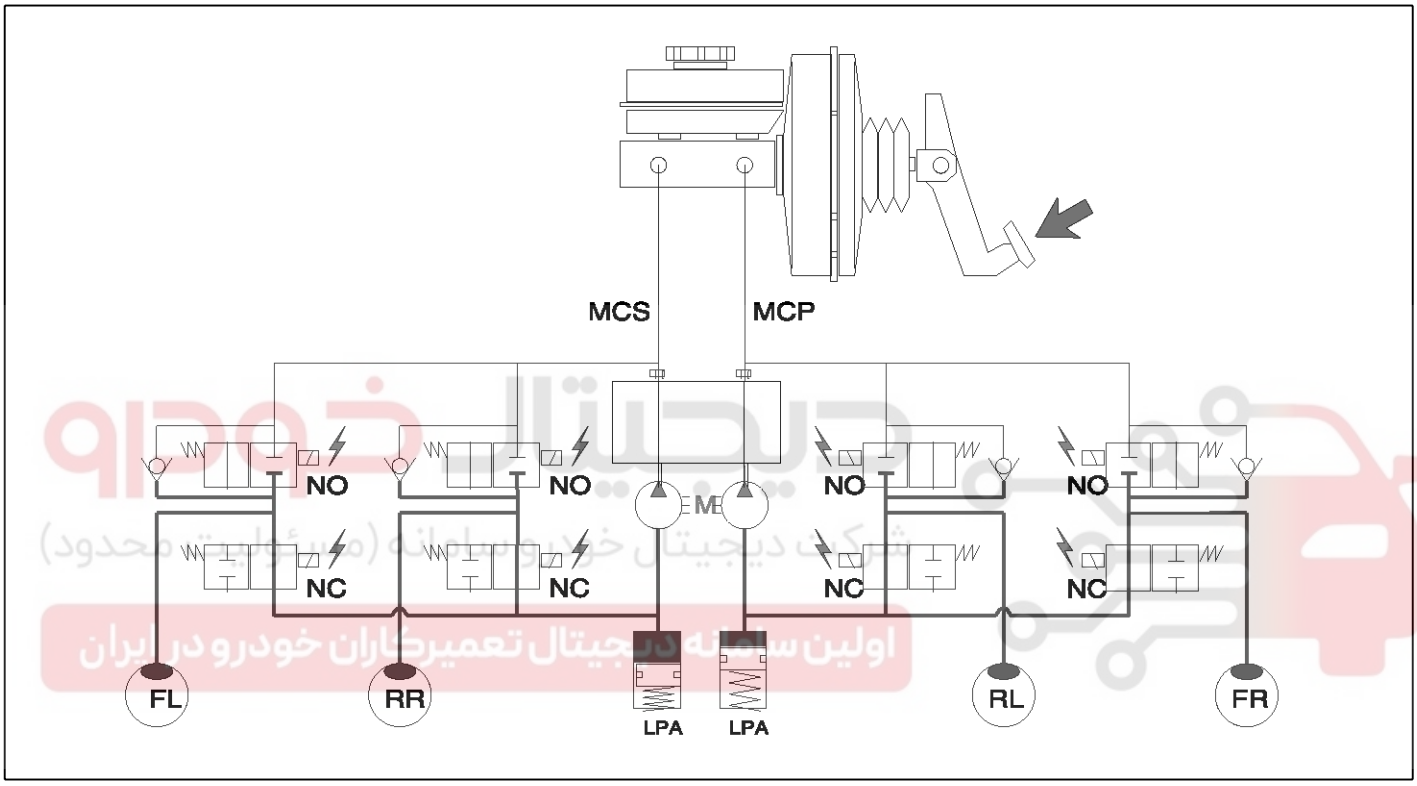
2. DUMP MODE

Solenoid valve	State	Valve	Passage	Pump motor
IN (NO)	ON	CLOSE	Master cylinder ⇔ Wheel cylinder	ON
OUT (NC)	ON	OPEN	Wheel cylinder ⇔ Reservoir	

Under the emergency braking, if the wheels start to lock up, HECU sends a signal to the solenoid valve to decrease the brake fluid, then voltage is supplied to each solenoid. At this time inlet valve is closed and brake fluid is blocked from the master cylinder. Conversely outlet valve is opened and brake fluid passes through wheel cylinder to reservoir, resulting in pressure decrease.



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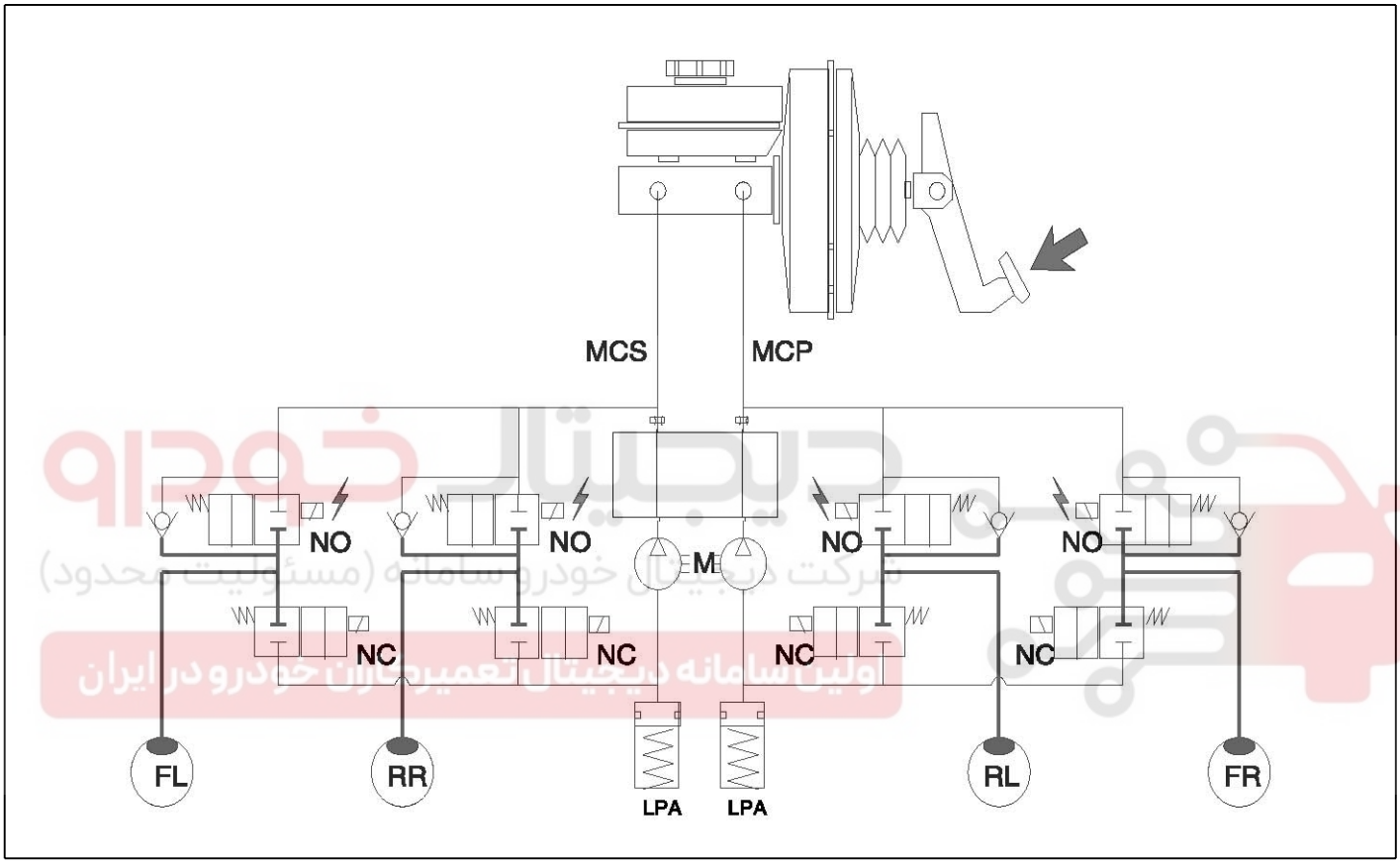
3. HOLD MODE

Solenoid valve	State	Valve	Passage	Pump motor
IN (NO)	ON	CLOSE	Master cylinder ⇔ Wheel cylinder	ON
OUT (NC)	OFF	CLOSE	Wheel cylinder ⇔ Reservoir	

When the brake fluid pressure is maximally decreased in wheel cylinder, HECU sends a signal to solenoid valve to keep the fluid pressure, voltage is supplied to inlet valve but it is not supplied to outlet valve. At this time inlet and outlet valves are closed and brake fluid is kept in wheel cylinder.



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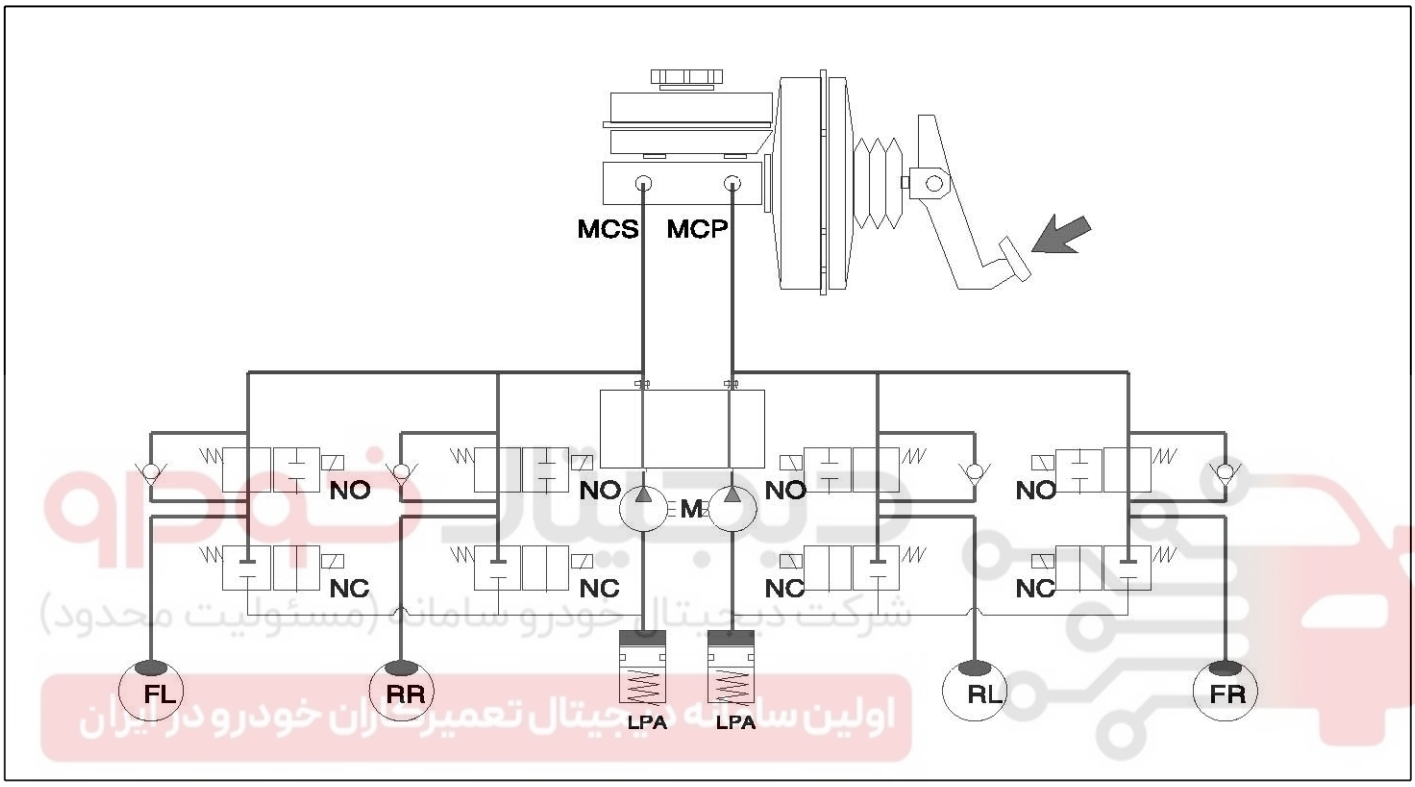
4. INCREASE MODE

Solenoid valve	State	Valve	Passage	Pump motor
IN (NO)	OFF	OPEN	Master cylinder ⇔ Wheel cylinder	ON
OUT (NC)	OFF	CLOSE	Wheel cylinder ⇔ Reservoir	

If HECU determines there's no lock-up in the wheel, HECU cuts voltage to solenoid valve. So voltage is not supplied to each solenoid valve, brake fluid passes through the inlet valve to wheel cylinder, resulting in pressure increase.



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TRACTION CONTROL SYSTEM (TCS) OPERATION

1. NORMAL MODE

Solenoid valve	State	Valve	Motor pump	TC valve
IN (NO)	OFF	OPEN	OFF	OFF
OUT (NC)	OFF	CLOSE		

- In the normal driving condition, TC valve (normally open) is the passage between the master cylinder and the each wheel cylinder.
- When brake pedal is applied, brake pressure is delivered to the wheel cylinders via NO-TC valve and all solenoid v-alves inside the hydraulic unit are deactivated.
- In case of TCS malfunction it does not affect brake operation.

2. PRESSURE INCREASE MODE

Solenoid valve	State	Valve	Motor pump	TC valve
IN (NO)	FRONT:OFF REAR:ON	FRONT:OPEN REAR:CLOSE	ON	ON
OUT (NC)	OFF	CLOSE		

- If a front wheel spin is detected, TCS begins a brake control to decrease a wheel spin.
- Hydraulic shuttle valve (HSV) is opened.
  Brake fluid is supplied from the master cylinder by motor operation to the spin wheel via HSV.
- TC valve is closed (ON).
  Brake pressure generated from motor pump is delivered only to the front wheel.
- Inlet valve remains open to deliver the brake pressure generated from motor pump to the spinning wheels.

3. PRESSURE DUMP MODE

Solenoid valve	State	Valve	Motor pump	TC valve
IN (NO)	ON	CLOSE	ON	ON
OUT (NC)	FRONT:ON REAR:OFF	FRONT:OPEN REAR:CLOSE		

- When the wheel deceleration is under the threshold and the wheel spin is reduced under a slip threshold, applied br-ake pressure is reduced to get a optimum traction force.
- Outlet valve is open to release the brake pressure and inlet valve is closed to block the pressure increase from the motor pump.
- Hydraulic shuttle valve (HSV) remains opened, TC valve is ON.
- Motor is ON, to dump the brake fluid being released from the lock-up wheel.

4. PRESSURE HOLD MODE

Solenoid valve	State	Valve	Motor pump	TC valve
IN (NO)	ON	CLOSE	ON	ON
OUT (NC)	OFF	CLOSE		

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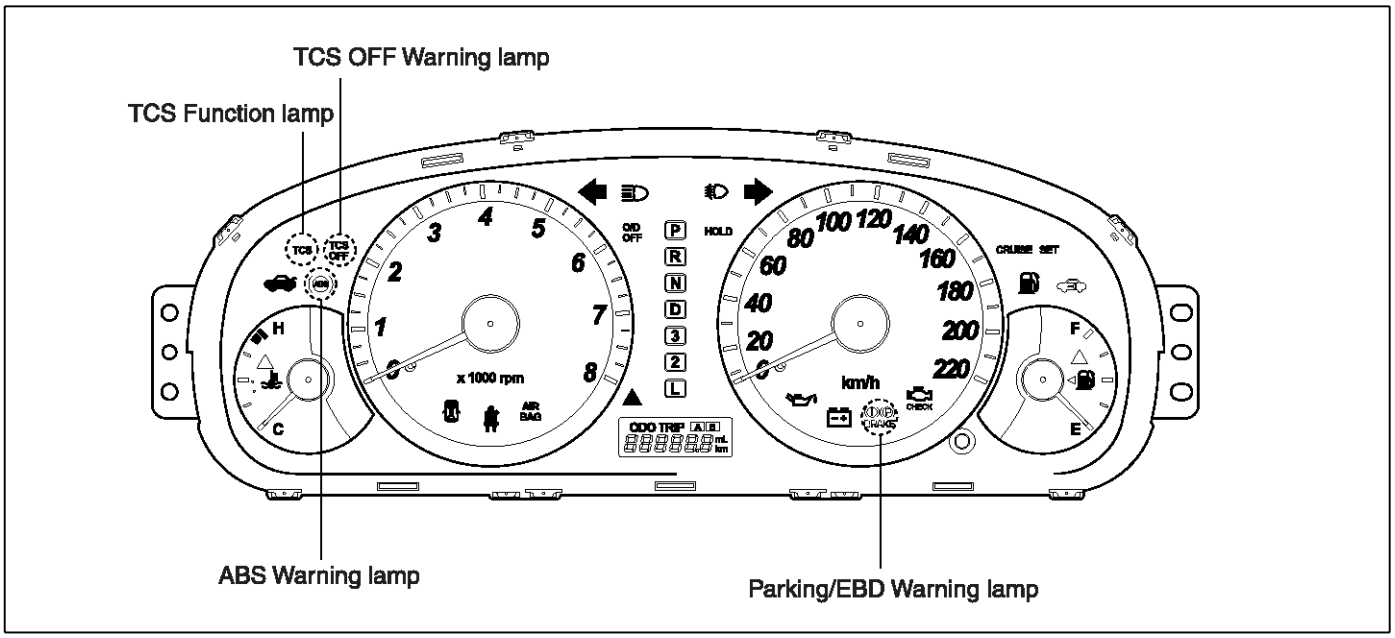
WARNING LAMP CONTROL



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1. ABS warning lamp module

   The ABS warning lamp module indicates the operating condition of the ABS.

   The ABS warning lamp is turned on under the following conditions.

   - During the initialization phase after ignition switch ON (3 seconds).
   - In the event of inhibition of ABS functions by failure.
   - When the system ECU is shut down even though ignition power is applied.
   - During diagnostic mode.
   - When the HECU connector is disconnected.

2. EBD warning lamp module

   The EBD warning lamp module indicates the operating condition of the EBD. However, in case the parking brake switch is turned on, the EBD warning lamp is always turned on regardless of EBD functions.

   The EBD warning lamp is turned on under the following conditions.

   - During the initialization phase after ignition switch ON. (3 seconds).
   - When the system ECU is shut down even though ignition power is applied.
   - When the parking brake switch is ON or brake fluid is low level.
   - In the event of inhibition of EBD functions by failure.

3. TCS lamp module

   The TCS warning lamp module indicates the operating condition of the TCS.

   The TCS warning lamp is turned on under the following conditions :

   - During the initialization phase after ignition switch ON (3 seconds).
   - In the event of inhibition of TCS functions by failure.
   - When the TCS OFF switch is turned on.

   TCS function lamp is turned on when the TCS functions are operating (Blinking-2Hz).

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BLEEDING OF BRAKE SYSTEM

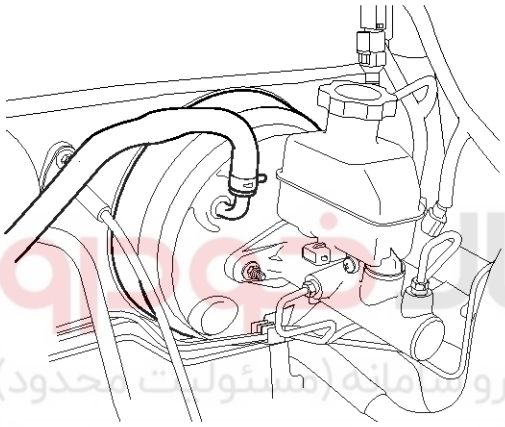
This procedure should be followed to ensure adequate bleeding of air and filling of the ABS unit, brake lines and master cylinder with brake fluid.

1. Remove the reservoir cap (A) and fill the brake reservoir with brake fluid.

   CAUTION
   If there is any brake fluid on any painted surface, wash it off immediately.

   NOTICE
   When pressure bleeding, do not depress the brake pedal.

Recommended fluid..... DOT3 or DOT4



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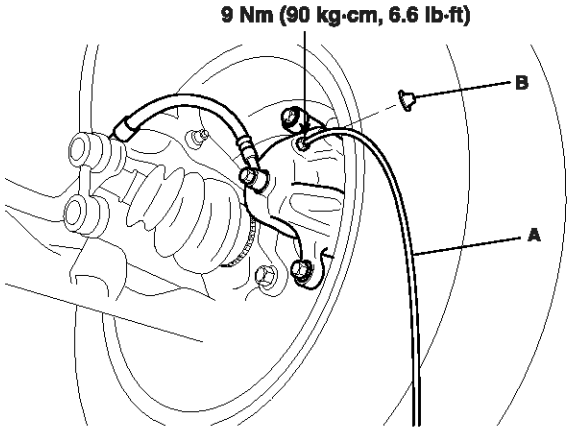
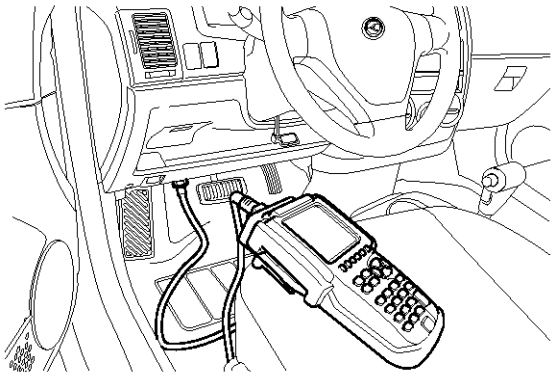
2. Connect a clear plastic tube to the wheel cylinder bleeder plug (A) and insert the other end of the tube into a half filled clear plastic bottle.



BJGE501B

3. Connect the hi-scan (pro) to the data link connector located underneath the dash panel.

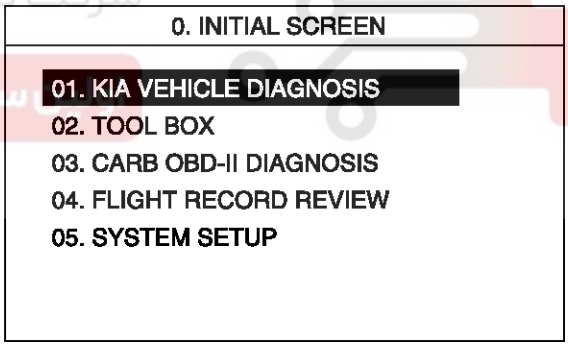


AJGE504C

4. Select and operate according to the instructions on the hi-scan (Pro) screen.

   CAUTION
   You must obey the maximum operating time of the ABS motor with the hi-scan (Pro) to prevent the motor pump from burning.

   1) Select kia vehicle diagnosis.



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2) Select vehicle name.
3) Select Anti-Lock Brake system.

KIA VEHICLE DIAGNOSIS
MODEL :
01. ENGINE CONTROL 02. AUTOMATIC TRANSAXLE 03. ANTI-LOCK BRAKE SYSTEM 04. SRS-AIRBAG 05. IMMOBILIZER 06. CODE SAVING

BJGE501D

4) Select air bleeding mode.

KIA VEHICLE DIAGNOSIS
MODEL : SYSTEM : ANTI-LOCK BRAKE SYSTEM
01. DIAGNOSTIC TROUBLE CODES 02. CURRENT DATA 03. DUAL DISPLAY 04. FLIGHT RECORD 05. ACTUATION TEST 06. SIMU-SCAN 07. ECU ROM ID 08. HCU AIR BLEEDING MODE

BJGE501E

5) Press "YES" to operate motor pump and solenoid valve.

AIR BLEEDING MODE	
ABS AIR BLEEDING STATUS	
01. SOLENOID VALVE STATUS	CLOSE
02. MOTOR PUMP STATUS	OFF
DO YOU WANT TO START ? (PRESS [YES] KEY)	

EJDA014F

6) Wait 60 sec. before operating the air bleeding. (If not, you may damage the motor.)

AIR BLEEDING MODE	
ABS AIR BLEEDING STATUS	
01. SOLENOID VALVE STATUS	OPEN
02. MOTOR PUMP STATUS	ON
TIME : AUTOMATIC COUNT (1-60 SEC.)	

EJDA014G

<FINAL BLEEDING>
1. Perform the bleeding of conventinal parts certainly. 2. If the brake pedal stroke is not so good after above procedure, perform the all procedure more some times and recheck the brake pedal stroke. 3. Press [ENTER] key to return the first bleeding mode.

BJGE501F

5. Pump the brake pedal several times, and then loosen the bleeder screw until fluid starts to run out without bubbles. Then close the bleeder screw.

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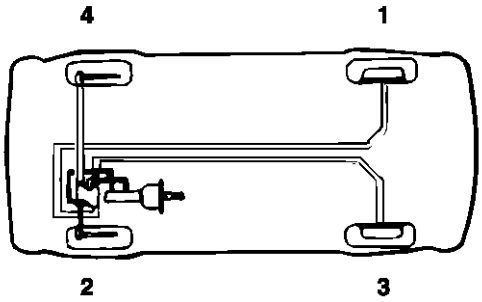
6. Repeat step 5 until there are no more bubbles in the fluid for each wheel.



EJDA014H

7. Tighten the bleeder screw.

Bleed screw tightening torque:
7 ~ 13 Nm (70 ~130 kg·cm, 5 ~ 9 lb·ft)

HECU CONNECTOR INPUT/OUTPUT

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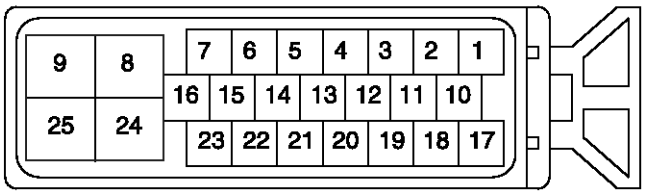
(ECU wire harness side connector)



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Terminal No.	ABS
1	Wheel speed sensor (Front left)
2	Wheel speed sensor (Front left)
3	Wheel speed sensor output (Front right)
4	Start/ON power source (system)
5	Wheel speed sensor (Rear left)
6	Wheel speed sensor (Rear left)
7	Self-diagnosis line
8	Ground
9	Battery 2 (Motor)
10	CAN BUS Line (low) - For TCS system
11	CAN BUS Line (high) - For TCS system
12	-
13	-
14	TCS ON/OFF switch - For TCS system
15	-
16	ABS/EBD warning lamp output
17	TCS warning lamp output - For TCS system
18	Brake lamp switch input
19	Wheel speed sensor (Front rignt)
20	Wheel speed sensor (Front rignt)
21	TCS Function lamp output - For TCS system
22	Wheel speed sensor (Rear right)
23	Wheel speed sensor (Rear right)
24	Ground
25	Battery 1 (Solenoid valve)

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HECU INPUT/OUTPUT SPECIFICATION (ABS&TCS)

Connector Terminal			Specification	Note
No	Mark	Terminal Name		
4	IGN+	Power source via Ignition Switch terminal	Over voltage range : 16.5±0.5V < V < 20V Operating voltage range : 9.5±0.5V < V < 16.5±0.5V Low voltage range : 8.0V < V < 9.5±0.5V System down range : V < 7.5±0.5V Max. current : I < 300mA	
8 24	GND1 GND2	Ground terminal	Max. current(total of 2 terminals) : I < 60A	In ABS control
18	BRAKE	Brake lamp switch input terminal	Input voltage(Low) : -1.00 < V(IL) < 2.00V Input voltage(High) : 7.00 < V(IH) < 16.00V	
1 19 5 23 2 20 6 22	FL+ FR+ RL+ RR+ FL- FR- RL- RR-	Wheel sensor input terminal	Min. sensor voltage : Vs > 130mVpp Resistance : 1100Ω ± 50% Input range : 30 ~ 2000Hz Inductance : 0.7H ± 50% Permissible offset voltage range : 2.15V < Voffset < 3.5V	
16	WLP	ABS and EBD warning lamp output terminal	Max. current : I < 200mA Saturation voltage, at I = 200mA : Vsat < 1.5V	
7	Diag	Diagnosis interface terminal	Input voltage : V(IL) < 0.3VB V V(IH) > 0.7VB V Output voltage : V(OL) < 0.2VB V V(OH) > 0.8VB V	Vb : Ignition Voltage
3	FR-out	Wheel speed output terminal	Max. current : I < 10mA External pull up resistance : above 10kΩ (Open collector type)	
25	Batt1	Battery power source 1 terminal (valve power source)	Max. current(Inside control): I < 30A Max. current(Outside control) : I < 20mA	
9	Batt2	Battery power source 2 terminal (Motor power source)	* In ABS control Max. rush current : I < 100A (t < 100 msec) Max. current : I < 30A(t >100 msec) * At IGN off Dark current : I < 0.5mA	t: the running time of motor
14	TCS Switch	TCS ON/OFF switch	Input Voltage : -1.0≤V≤16.0V	
17	TCS OFF Lamp	TCS OFF lamp output	Max. current : I < 200mA	

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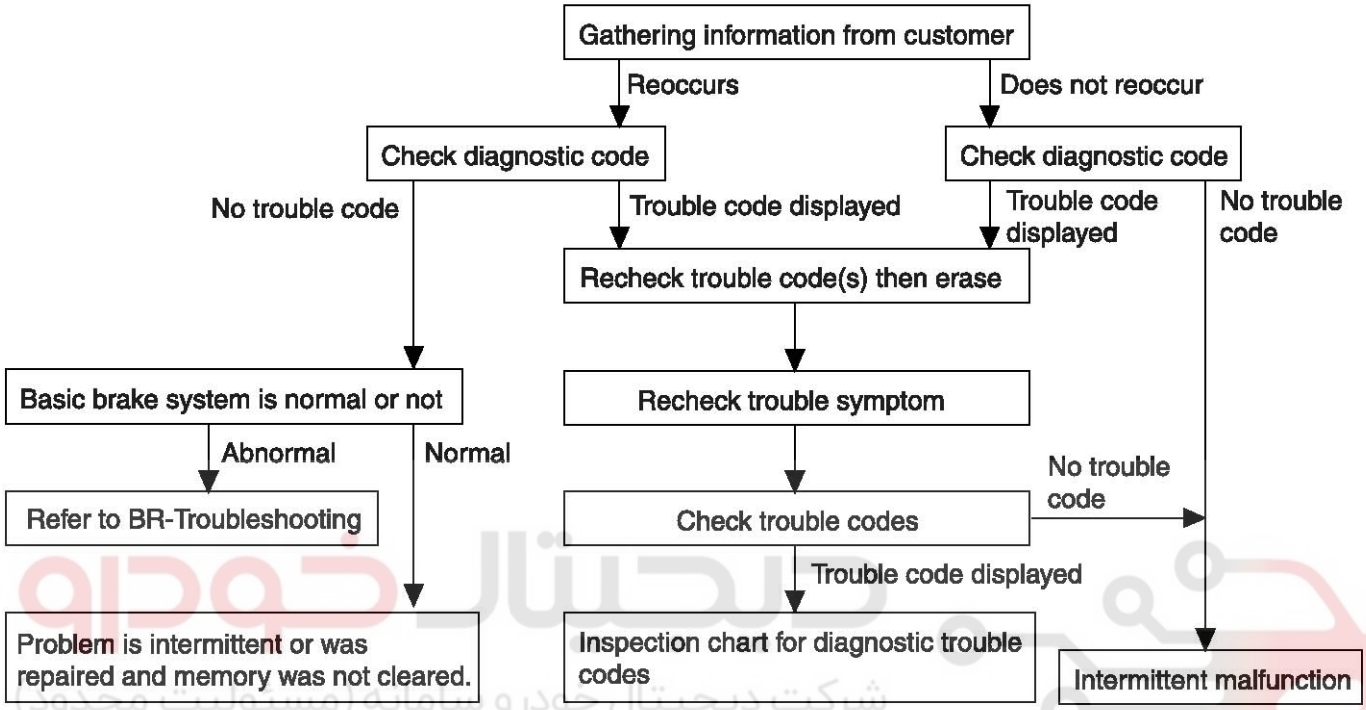
21	TCS F/Lamp	TCS function lamp output	Max. current : I < 200mA	

TROUBLESHOOTING

STANDARD FLOW OF DIAGNOSTIC TROUBLESHOOTING



*** Using the customer problem analysis check sheet for reference, ask the customer as much detail as possible about the problem.**

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NOTES WITH REGARD TO DIAGNOSIS

The phenomena listed in the following table are not abnormal.

Phenomenon	Explanation
System check sound	When starting the engine, a thudding sound can sometimes be heard coming from inside the engine compartment. This is because the system operation check is being performed.
ABS operation sound	1. Sound of the motor inside the ABS hydraulic unit operation (whine). 2. Sound is generated along with vibration of the brake pedal (scraping). 3. When ABS operates, sound is generated from the vehicle chassis due torepeated brake application and release (Thump : suspension: squeak: tires)
ABS operation (Long braking distance)	For road surfaces such as snow-covered and gravel roads, the braking distance for vehicles with ABS can sometimes be longer than that for other vehicles. Accordingly, advise the customer to drive safely on such roads by lowering the vehiclespeed.
Pedal kick back	Pedal kick back is normal operation.
Diagnosis detection conditions can vary depending on the diagnosis code. When checking the trouble symptom after the diagnosis code has been erased, ensure that the requirements listed in "Comment" are met.	

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ABS CHECK SHEET

ABS Check Sheet

Inspector's Name _____

Customer's Name		**Registration No.**	
		Registration Year	/ /
		VIN.	
Date Vehicle Brought In	/ /	**Odometer**	Km Miles

Date the Problem First Occurred	/ /
Frequency of Occurence of Problem	☐ Continuous ☐ Intermittent (times a day)

Symptoms	☐ ABS does not operate.		
	☐ ABS does not operate efficiently.	☐ Intermittent (	times a day)
	ABS Warning Light Abnormal	☐ Remains ON	☐ Does not light up

Diagnostic Trouble Code Check	**1st Time**	☐ Normal Code	☐ Malfunction Code (Code)
	2nd Time	☐ Normal Code	☐ Malfunction Code (Code)

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Diagnostic trouble code (DTC)

1. If the CPU cannot be activated or the CPU fails, the ABS indicator comes on.
2. The memory can hold any number of DTCs. However, when the same DTC is detected more than once, the later one is written over the old one.

   Therefore, when the same problem is detected repeatedly, it is memorized as one DTC.
3. The DTCs are indicated in the order they occur.
4. The DTCs are memorized in the EEPROM (non - volatile memory). Therefore, the memorized DTCs cannot be canceled by disconnecting the battery. Perform the specified procedures to erase the DTCs.

Self-diagnosis

1. Self diagnosis can be classified into two categories:
   - Initial diagnosis:

     Performed right after the engine starts and until the ABS indicator goes off.
   - Regular diagnosis:

     Performed right after the initial diagnosis until the ignition switch is turned OFF.
2. When a problem is detected by self-diagnosis, the system:
   - Turns the solenoid valve OFF
   - Turns the pump motor OFF
   - Turns the ABS indicator ON

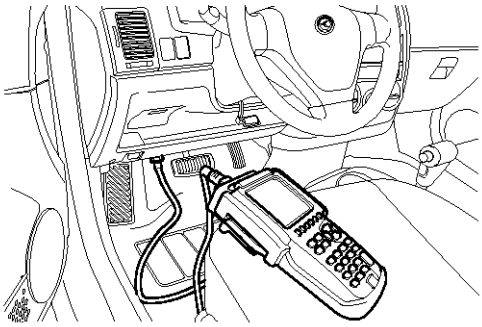
How to troubleshoot ABS DTC

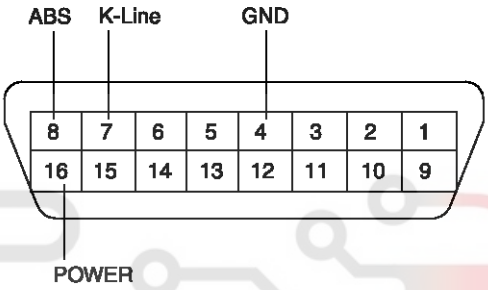
The troubleshooting flowchart procedures assume that the cause of the problem is still present and the ABS indicator is still on. Following the flowchart when the ABS indicator does not come on can result in incorrect diagnosis.

1. Question the customer about the conditions when the problem occured, and try to reproduce the same conditions for troubleshooting. Find out when the ABS indicator came on, such as during initial diagnosis, during ABS control, after ABS control, when vehicle speed was at a certain speed, etc.
2. When the ABS indicator does not come on during the test-drive, but troubleshooting is performed based on the DTC. Check for loose connectors, poor contact of the terminals, etc. before you start troubleshooting.
3. After troubleshooting, erase the DTC and test-drive the vehicle. Be sure the ABS indicator does not come on.

HI-SCAN (PRO) CHECK

1. Turn the ignition switch OFF.
2. Connect the Hi-scan (pro) to the 16P data link connector located behind the driver's side kick panel.





BJGE502B

3. Turn the ignition switch ON.
4. Check for diagnostic trouble codes using the Hi-scan (pro).
5. After completion of the repair or correction of the problem, erase the stored fault codes using the clear key on the Hi-scan (pro).
6. Disconnect the Hi-scan (pro) from the 16P data link connector.

PROBLEM SYMPTOMS TABLE

If a normal code is displayed during the DTC check but the problem still occurs, check the circuits for each problem symptom in the order given in the table below and proceed to the relevant troubleshooting page.

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Symptom	Suspect Area
ABS does not operate.	Only when 1. -4. are all normal and the problem is still occurring, replace the HECU. 1. Check the DTC reconfirming that the normal code is output. 2. Power source circuit. 3. Speed sensor circuit. 4. Check the hydraulic circuit for leakage.
ABS does not operate intermittently.	Only when 1. -4. are all normal and the problem is still occurring, replace the ABS actuator assembly. 1. Check the DTC reconfirming that the normal code is output. 2. Wheel speed sensor circuit. 3. Stop lamp switch circuit. 4. Check the hydraulic circuit for leakage.
Communication with Hi-scan (pro) is not possible. (Communication with any system is not possible)	1. Power source circuit 2. Diagnosis line
Communication with Hi-scan (pro) is not possible. (Communication with ABS only is not possible)	1. Power source circuit 2. Diagnosis line 3. HECU
When ignition key is turned ON (engine OFF), the ABS warning lamp does not light up.	1. ABS warning lamp circuit 2. HECU
Even after the engine is started, the ABS warning lamp remains ON.	1. ABS warning lamp circuit 2. HECU
Brake warning lamp is abnormal.	1. Brake oil level sensor 2. Parking brake switch 3. Brake warning lamp circuit

⚠CAUTION

During ABS operation, the brake pedal may vibrate or may not be able to be depressed. Such phenomena are due to intermittent changes in hydraulic pressure inside the brake line to prevent the wheels from locking and is not an abnormality.

Inspection procedure for trouble symptoms

1. ABS DOES NOT OPERATE

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DETECTING CONDITION

Trouble Symptoms	Possible Cause
Brake operation varies depending on driving conditions and road surface conditions, so diagnosis can be difficult. However if a normal DTC is displayed, check the following probable cause. When the problem is still occurring, replace the ABS control module.	- Faulty power source circuit - Faulty wheel speed sensor circuit - Faulty hydraulic circuit for leakage - Faulty HECU

INSPECTION PROCEDURES

1. CHECK THE DTC RECONFIRMING THAT THE NORMAL CODE IS OUTPUT.

1. Connect the Hi-Scan (pro) with the data link connector and turn the ignition switch ON.
2. Verify that the normal code is output.

Is the normal code output?

Yes	No	Erase the DTC and recheck using Hi-Scan (pro).

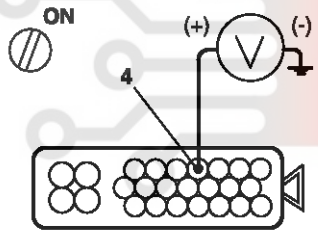
BJGE510A

2. CHECK THE POWER SOURCE CIRCUIT.

1. Disconnect the connector from the ABS control module.
2. Turn the ignition switch ON, measure the voltage between terminal 4 of the ABS control module harness side connector and body ground.

- **Specification: approximately B+**

Is the voltage within specification?



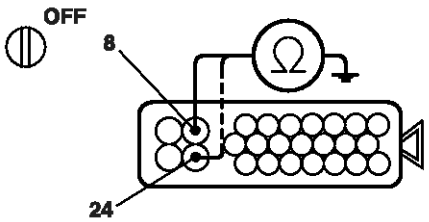
Yes	No	Check the harness or connector between the fuse (10A) in the passenger compartment junction block and the ABS control module. Repair if necessary.

BJGE510B

3. CHECK THE GROUND CIRCUIT.

1. Disconnect the connector from the ABS control module.
2. Check for continuity between terminals 8, 24 of the ABS control module harness side connector and ground point.

Is there continuity?



Yes	No	Repair an open in the wire and ground point.

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4. CHECK THE WHEEL SPEED SENSOR CIRCUIT.

Refer to the DTC troubleshooting procedures.

OK	
NG	Repair or replace the wheel speed sensor.

BJGE510D

5. CHECK THE HYDRAULIC CIRCUIT FOR LEAKAGE.

Refer to the hydraulic lines.

OK	
NG	Repair the hydraulic lines for leakage.

The problem is still occurring, replace the ABS control module.

BJGE510E

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2. ABS DOES NOT OPERATE INTERMITTENTLY

DETECTING CONDITION

Trouble Symptoms	Possible Cause
Brake operation varies depending on driving conditions and road surface conditions, so diagnosis can be difficult. However if a normal DTC is displayed, check the following probable cause. When the problem is still occurring, replace the ABS control module.	- Faulty wheel speed sensor circuit - Faulty stop lamp switch circuit - Faulty hydraulic circuit for leakage - Faulty HECU

INSPECTION PROCEDURES

1. CHECK THE DTC RECONFIRMING THAT THE NORMAL CODE IS OUTPUT.

1. Connect the Hi-Scan (pro) to the data link connector and turn the ignition switch ON.
2. Verify that the normal code is output.

Is the normal code output?

Yes	
No	Erase the DTC and recheck using Hi-Scan (pro).

BJGE511A

2. CHECK THE WHEEL SPEED SENSOR CIRCUIT.

Refer to the DTC troubleshooting procedures.

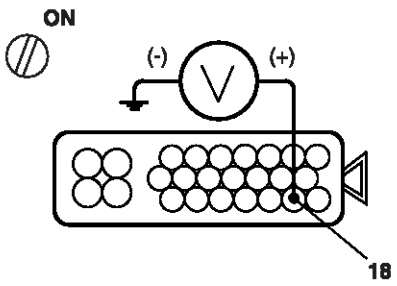
OK	
NG	Repair or replace the wheel speed sensor.

BJGE511B

3. CHECK THE STOP LAMP SWITCH CIRCUIT.

1. Check that stop lamp lights up when brake pedal is depressed and turns off when brake pedal is released.
2. Measure the voltage between terminal 18 of the ABS control module harness side connector and body ground when brake pedal is depressed.

- **Specification: approximately B+**



Is the voltage within specification?

Yes	
No	Repair the stop lamp switch. Repair an open in the wire between the ABS control module and the stop lamp switch.

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BJGE511C

4. CHECK THE HYDRAULIC CIRCUIT FOR LEAKAGE.

Refer to the hydraulic lines.

OK	
NG	Repair the hydraulic lines for leakage.

The problem is still occurring, replace the ABS control module.

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3. COMMUNICATION WITH HI-SCAN (PRO) IS NOT POSSIBLE (COMMUNICATION WITH ANY SYSTEM IS NOT POSSIBLE)

DETECTING CONDITION

Trouble Symptoms	Possible Cause
Possible defect in the power supply system (including ground) for the diagnosis line.	- An open in the wire - Poor ground (G14)

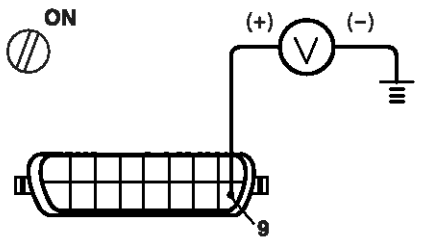
INSPECTION PROCEDURES

1. CHECK THE POWER SUPPLY CIRCUIT FOR THE DIAGNOSIS

Measure the voltage between terminal 9 of the data link connector and body ground.

- **Specification: approximately B+**

Is voltage within specification?



Yes

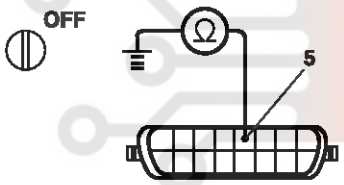
No	Repair an open in the wire. Check and replace fuse (15A) from the passenger compartment junction block

BJGE512A

2 . CHECK THE GROUND CIRCUIT FOR THE DIAGNOSIS

Check for continuity between terminal 5 of the data link connector and body ground.

Is there continuity?



No	Repair an open in the wire between terminal 5 of the data link connector and ground point.

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4. COMMUNICATION WITH HI-SCAN (PRO) IS NOT POSSIBLE (COMMUNICATION WITH ABS ONLY IS NOT POSSIBLE)

DETECTING CONDITION

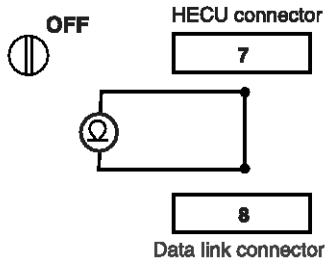
Trouble Symptoms	Possible Cause
When communication with Hi-Scan (pro) is not possible, the cause may be probably an open in the HECU power circuit or an open in the diagnosis output circuit.	- An open in the wire - Blown fuse (10A) in the passenger compartment junction block - Faulty HECU

INSPECTION PROCEDURES

1. CHECK FOR CONTINUITY IN THE DIAGNOSIS LINE

1. Disconnect the connector from the ABS control module.
2. Check for continuity between terminals 7 of the ABS control module connector and 8 of the data link connector.

Is there continuity?



Yes	
No	Repair an open in the wire.

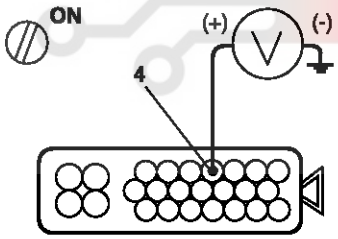
BJGE513A

2. CHECK THE POWER SOURCE OF ABS CONTROL MODULE

1. Disconnect the connector from the ABS control module.
2. Turn the ignition switch ON, measure the voltage between terminal 4 of the ABS control module harness side connector and body ground.

- **Specification: approximately B+**

Is voltage within specification?



Yes	
No	Check the harness or connector between the fuse (10A) in the passenger compartment junction block and the ABS control module. Repair if necessary.

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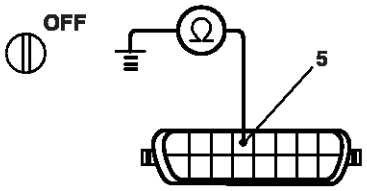
3 . CHECK FOR POOR GROUND

Check for continuity between terminal 5 of the data link connector and ground point.

Is there continuity?



Yes

No	Repair an open in the wire or poor ground.

Replace the ABS control module and recheck.

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5. WHEN IGNITION KEY IS TURNED ON (ENGINE OFF), THE ABS WARNING LAMP DOES NOT LIGHT UP

DETECTING CONDITION

Trouble Symptoms	Possible Cause
When current flows in the HECU the ABS warning lamp turns from ON to OFF as the initial check. Therefore if the lamp does not light up, the cause may be an open in the lamp power supply circuit, a blown bulb, an open in the both circuits between the ABS warning lamp and the HECU, and the faulty HECU.	- Blown fuse (10A) in the passenger compartment junction block - An open in the wire - Faulty ABS warning lamp bulb - Faulty ABS warning lamp module - Faulty HECU

INSPECTION PROCEDURES

1 . PROBLEM VERIFICATION

Disconnect the connector from the ABS control module and turn the ignition switch ON.

Does the ABS warning lamp light up?

No	
Yes	Check for short circuit in the ABS control module connector.

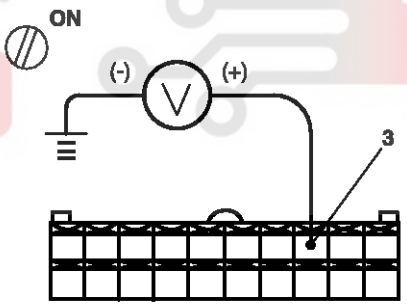
BJGE514A

2 . CHECK THE POWER SOURCE FOR THE ABS WARNING LAMP

1. Disconnect the instrument cluster connector and turn the ignition switch ON.
2. Measure the voltage between terminal 3 of the cluster harness side connector and body ground.

- **Specification: approximately B+**

Is voltage within specification?



No	
Yes	Repair bulb or instrument cluster assembly.

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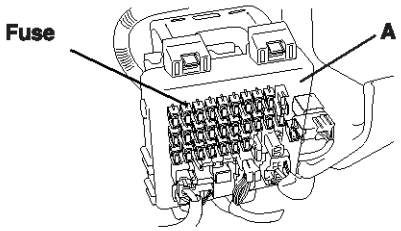
3 . CHECK FOR BLOWN FUSE

Check continuity of fuse (10A) from the passenger compartment junction block (A).

Is there continuity?



Yes		
	No	Replace the blown fuse.

Repair an open in the wire between terminals 12 of I/P-H connector and 3 of cluster connector.

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6. EVEN AFTER THE ENGINE IS STARTED, THE ABS WARNING LAMP REMAINS ON

DETECTING CONDITION

Trouble Symptoms	Possible Cause
If the HECU detects trouble, it lights the ABS warning lamp while at the same time prohibiting ABS control. At this time, the HECU records a D-TC in memory. Even though the normal code is output, the ABS warning lamp remains ON, then the cause may be probably an open or short in the ABS warning lamp circuit.	- An open in the wire - Faulty instrument cluster assembly - Faulty HECU

INSPECTION PROCEDURES

1 . CHECK DTC OUTPUT.

1. Connect the Hi-Scan (pro) to the 16P data link connector located behind the driver's side kick panel.
2. Check the DTC output using Hi-Scan (pro).

Is DTC output?

No	Yes	Repair circuit indicated by code output.

BJGE515A

2 . CHECK INSTRUMENT CLUSTER

Disconnect the cluster connector and turn the ignition switch ON.

Does the ABS warning lamp remains ON?

No	Yes	Replace the instrument cluster.

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3 . CHECK FOR OPEN IN THE WIRE

Check for continuity in the wire between cluster and ABS control module.

Is there continuity?

Yes	No	Repair an open in the wire between cluster and ABS control module.

Replace the ABS control module and recheck.

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7. BRAKE WARNING LAMP IS ABNORMAL

DETECTING CONDITION

Trouble Symptoms	Possible Cause
The brake warning lamp lights up when the brake oil is insufficient, parking brake is applied or EBD is defective.	- Faulty brake oil level sensor - Faulty parking brake switch - Faulty instrument cluster - Faulty HECU

INSPECTION PROCEDURES

1. CHECK PARKING BRAKE SWITCH CIRCUIT

OK

NG	Repair or replace parking brake switch circuit.

BJGE516A

2. CHECK BRAKE OIL LEVEL WARNING SWITCH CIRCUIT

OK

NG	Repair or replace brake oil level warning switch circuit.

BJGE516B

3. CHECK BRAKE WARNING LAMP CIRCUIT IN CLUSTER

OK

NG	Repair or replace the instrument cluster.

BJGE516C

4. CHECK FOR OPEN OR SHORT CIRCUIT IN HARNESS AND CONNECTOR

OK

NG	Repair or replace the harness and connector.

Replace the ABS control module and recheck.

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DIAGNOSTIC TROUBLE CODE CHART

Inspect according to the inspection chart that is appropriate for the malfunction code.

DTC No.	Detection Item	MIL *	Mem-ory
C1101	Battery voltage over volt: 18V or more	○	○
C1102	Battery voltage low volt: 9.5V or less	○	○
C1200	FL wheel sensor: open or short to ground	○	○
C1201	- Range/Performance: speed jump or damaged exciter	○	○
C1202	- No signal: air-gap error or wrong excite	○	○
C1203	FR wheel sensor: open or short to ground	○	○
C1204	- Range/Performance: speed jump or damaged exciter	○	○
C1205	- No signal excite: air-gap error or wrong excite	○	○
C1206	RL wheel sensor: open or short to ground	○	○
C1207	- Range/Performance: speed jump or damaged exciter	○	○
C1208	- No signal excite: air-gap error or wrong excite	○	○
C1209	RR wheel sensor: open or short to ground	○	○
C1210	- Range/Performance: speed jump or damaged exciter	○	○
C1211	- No signal: air-gap error or wrong excite	○	○
C1604	ECU hardware: ECU internal or valve failure	○	○
C2112	Valve relay: valve relay or fuse failure	○	○
C2380	Solenoid valve failure	△	○
C2402	Motor-Electrical: open or short to battery, motor relay, fuse or motor lock fail	○	○
C1503	TCS switch failure	×	○
C1605	CAN Hardware failure	△	○
C1611	EMS Time-out failure	△	○
C1612	TCM Time-out failure	△	○
C1613	TCM Un-matching failure	△	○
C2227	Brake disc overheat	△	○

NOTICE

**MIL: Malfunction Indication Lamp*

○: ABS warning lamp

△: TCS warning lamp

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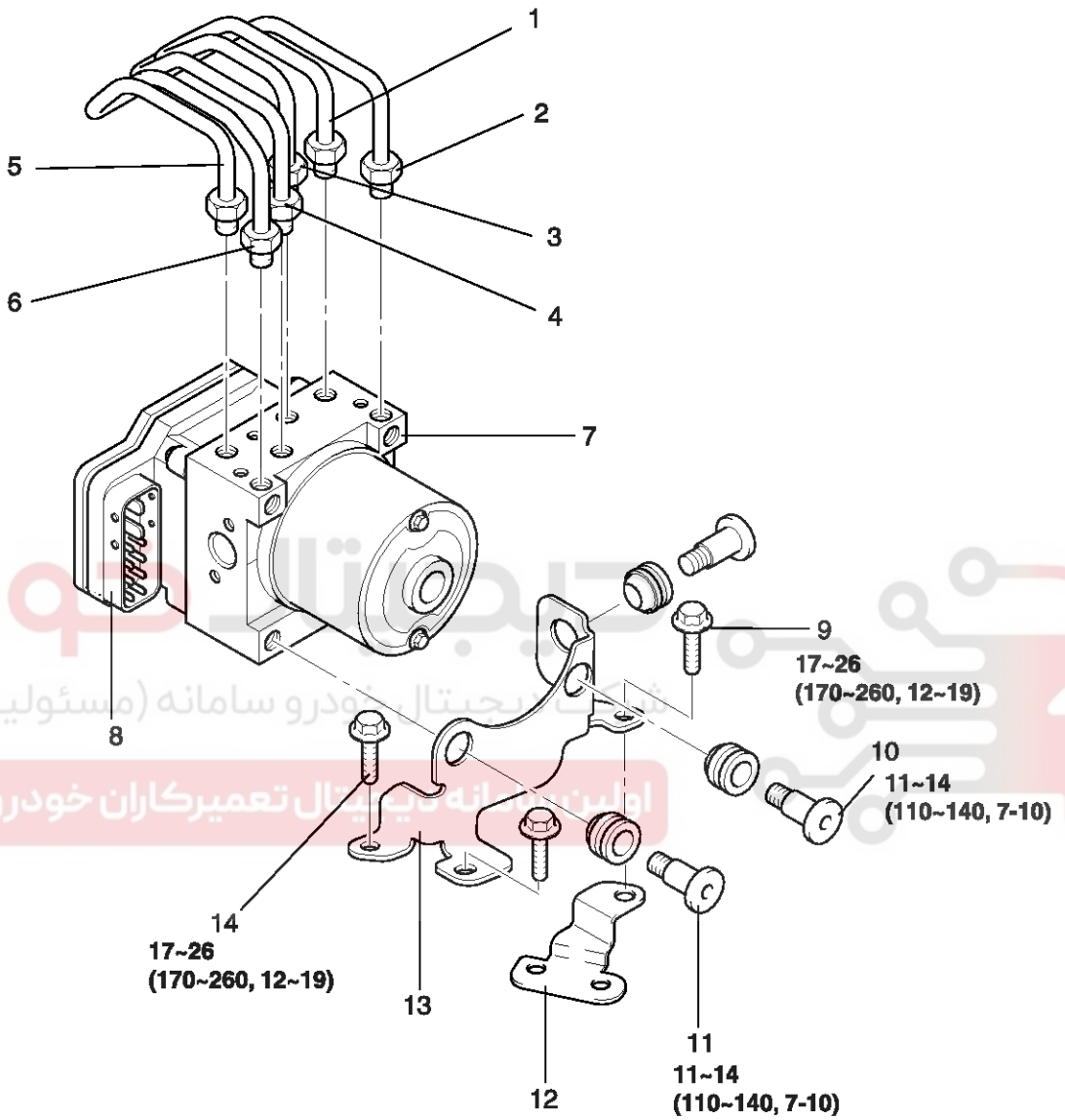
ABS Control Unit

COMPONENTS



TORQUE : Nm (kg·cm, lb·ft)

1. Front-right tube
2. Master Cylinder Primary (MCP) tube
3. Rear-left tube
4. Rear-right tube
5. Front-left tube
6. Master Cylinder Secondary (MCS) tube
7. ABS control module (HECU)
8. ABS control module connector (25P)
9. Bolt
10. Bolt
11. Bolt
12. Bracket
13. Bracket
14. Bolt

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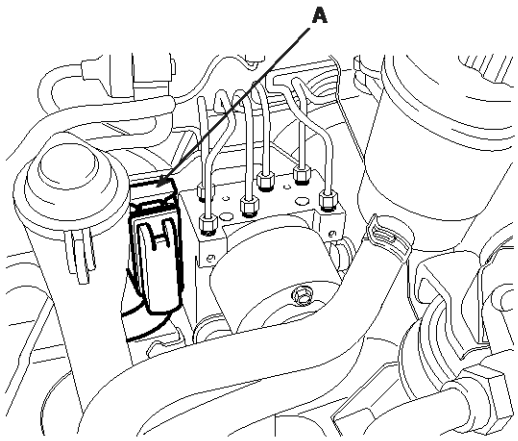
REMOVAL

1. Disconnect the double lock connector (A) from the HECU.



AJGE506C

2. Disconnect the brake tubes(A) from the HECU.

AJGE506D

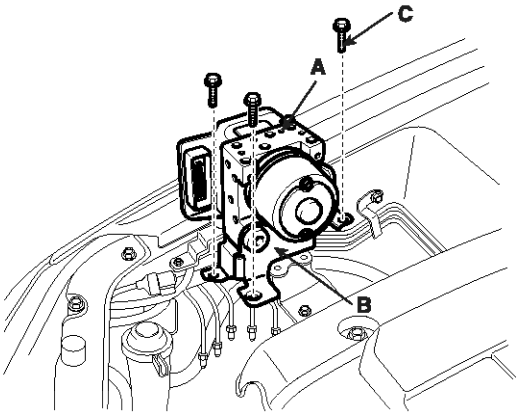
NOTICE

- *Do not spill brake fluid on the vehicle; it may damage the paint; if brake fluid gets on the paint, wash it off immediately with water.*
- *Take care not to damage or deform the brake lines during removal and installation.*
- *To prevent the brake fluid from flowing, plug and cover the hose ends and joints with a shop towel or equivalent material.*

3. Remove the HECU bracket mounting bolt and remove the HECU.

CAUTION

- **Never attempt to disassemble the HECU.**
- **The HECU must be transported and stored in an upright position and with the ports sealed. The HECU must not be drained.**



AJGE506E

INSTALLATION

1. Installation is the reverse of removal.
2. Tighten the HECU mounting bolts and brake tube nuts to the specified torque.

Tightening torque

HECU mounting bolt:
11~14 Nm (110~140 kg·cm, 7~10 lb·ft)
HECU bracket mounting bolt:
17~26 Nm (170~260 kg·cm, 12~19 lb·ft)
Brake tube nut:
13~17 Nm (130~170 kg·cm, 9~12 lb·ft)

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ABS OPERATION CHECK

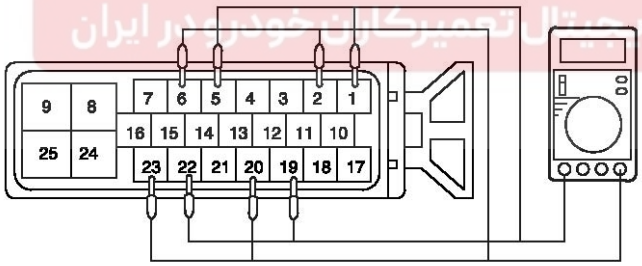
WHEEL SPEED SENSOR OUTPUT VOLTAGE CHECK

1. Raise the vehicle and release the parking brake.
2. Disconnect the HECU harness connector's and measure from the harness side connector.

   ⚠CAUTION
   Be sure to remove the connector's double lock and insert the probe into the harness side (back-probe). Inserting it into the terminal side may result in a bad connection.
3. Rotate the wheel to be measured approximately 1/2 to 1 rotation per second, and check the output voltage using a circuit tester or an oscilloscope.

Wheel speed sensor	Front left	Front right	Rear left	Rear right
Terminal	1	19	5	22
	2	20	6	23

Output voltage:
When measuring with an oscilloscope :
130mV p·p or more



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Front Wheel Speed Sensor

COMPONENTS

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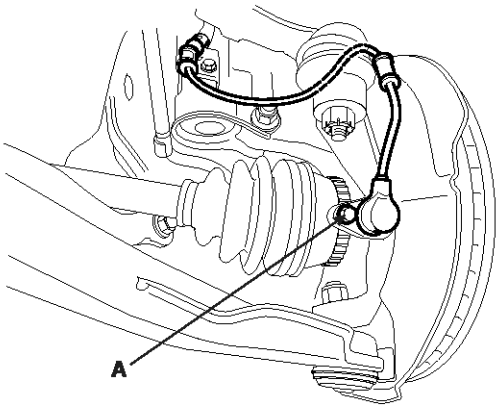
REMOVAL

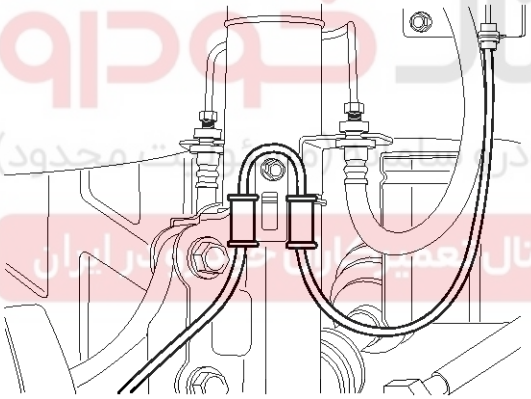
FRONT WHEEL SPEED SENSOR

1. Remove the front wheel speed sensor mounting bolt (A).



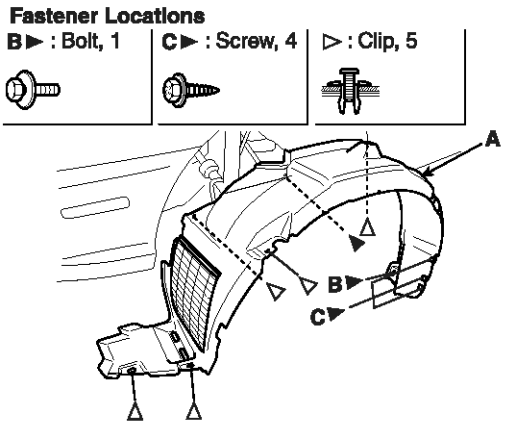
KJKD220A

2. Remove the mounting bolt fixed on the strut.



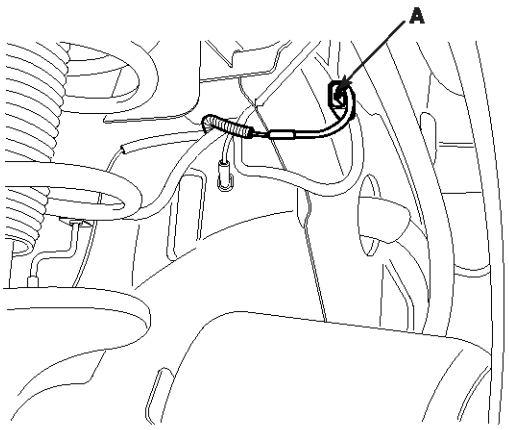
AJGE507B

3. Remove the front wheel guard (A).



ESKE006F

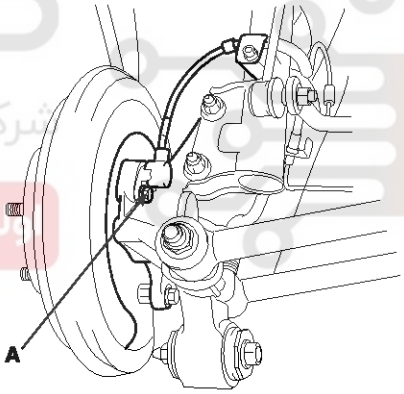
4. Remove the front wheel speed sensor after disconnecting the wheel speed sensor connector (A).



AJGE507D

REAR WHEEL SPEED SENSOR

1. Remove the rear wheel speed sensor mounting bolt (A).



EJKE002G

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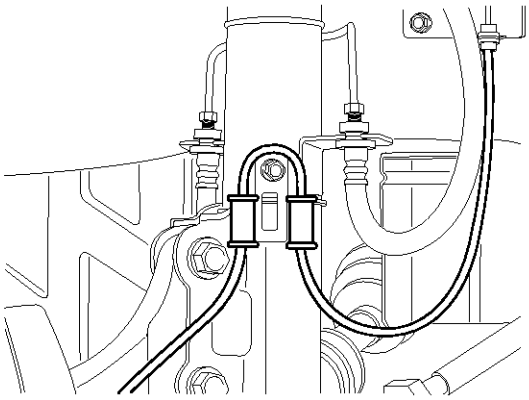
2. Remove the mounting bolt fixed on the strut.

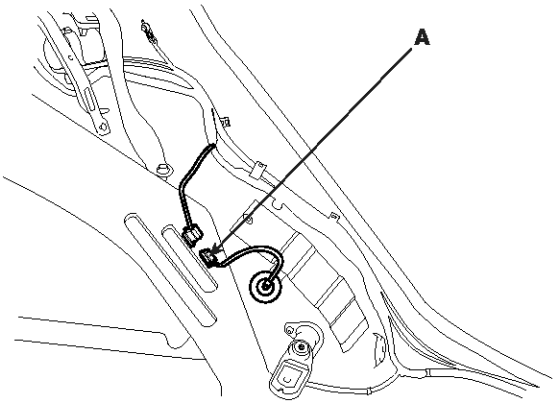


AJGE507B

3. Remove rear cushion and rear bag.

AJGE507F

4. Remove the rear seat side pad then disconnect the rear wheel speed sensor connector (A).

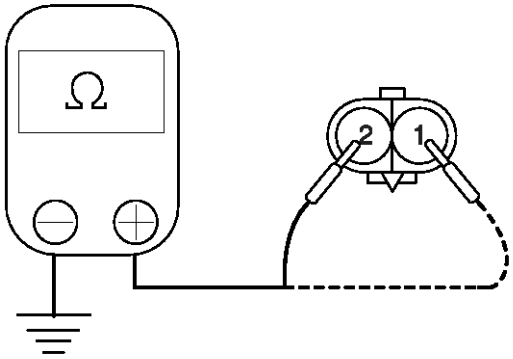


EJKD120A

INSPECTION

1. Connect an ohmmeter between the wheel speed sensor terminals and measure the resistance.

Service standard
Front : 1275 ~ 1495Ω
Rear : 1275 ~ 1495Ω



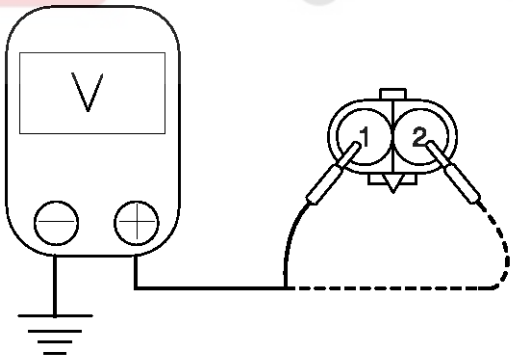
EJKB071A

2. Connect a voltmeter between the wheel speed sensor terminals and measure the voltage by turning the wheel.

NOTICE

Set the voltmeter to measure AC voltage.

Service standard: AC voltage detected.



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EBD (Electronic Brake force Distribution)

EBD (ELECTRONIC BRAKE-FORCE DISTRIBUTION) OPERATION

The EBD system (Electronic Brake force Distribution) as a sub-system of the ABS system is to control the effective adhesion utilization by the rear wheels.

It further utilizes the efficiency of highly developed ABS equipment by controlling the slip of the rear wheels in the partial braking range.

The brake force is moved even closer to the optimum and controlled electronically, thus dispensing with the need for the proportioning valve.

The proportioning valve, because of a mechanical device, has limitations to achieve an ideal brake force distribution tothe rear wheels as well as to carry out the flexible brake force distribution proportioning to the vehicle load or weight increasing. And in the event of malfunctioning, driver cannot notice whether it fails or not.

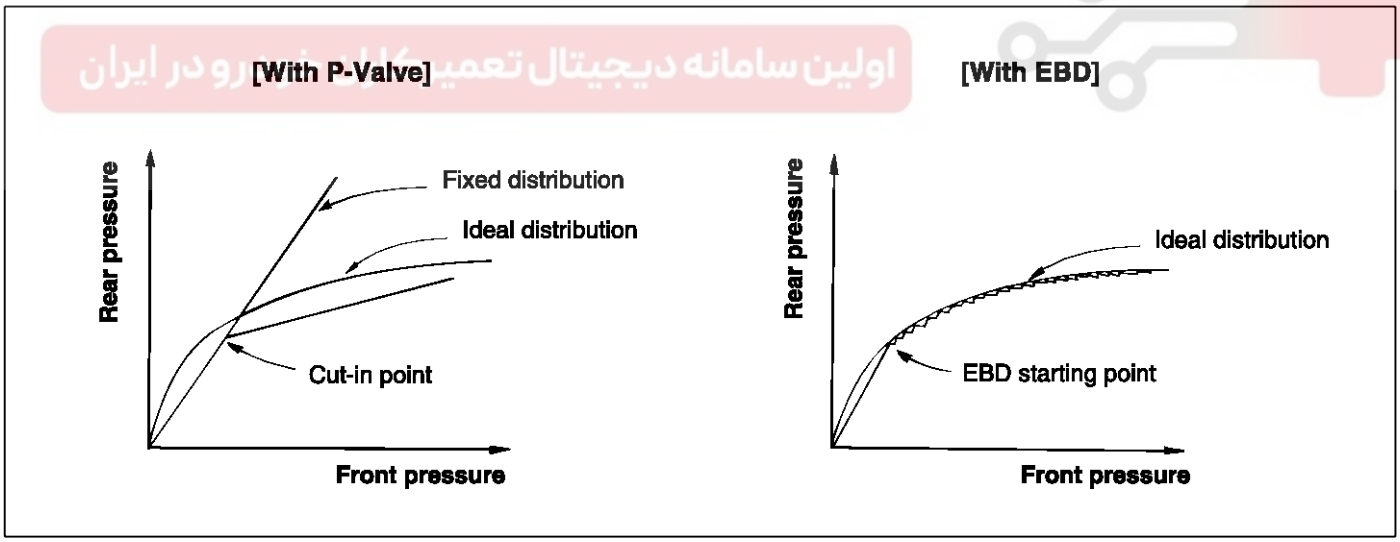
EBD controlled by the ABS Control Module, calculates the slip ratio of each wheel at all times and controls the brake pressure of the rear wheels not to exceed that of the front wheels.

If the EBD fails, the EBD warning lamp (Parking brake lamp) lights up.

ADVANTAGES

- Function improvement of the base-brake system.
- Compensation for the different friction coefficients.
- Elimination of the proportioning valve.
- Failure recognition by the warning lamp.

Comparison between Proportioning valve and EBD



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FAIL SAFE

FAIL CAUSE	SYSTEM		WARNING LAMP	
	ABS	EBD	ABS	EBD
None	ON	ON	OFF	OFF
1-Wheel speed sensor failure	OFF	ON	ON	OFF
Pump malfunction	OFF	ON	ON	OFF
Low voltage	OFF	ON	ON	OFF
2 or more wheel speed sensor failure Solenoid valve failure HECU malfunction Valve relay failure Over voltage Other failure	OFF	OFF	ON	ON

INSPECTION PROCEDURES FOR DIAGNOSTIC TROUBLE CODES

Battery Voltage out of Range

DTC	C1101 (Over Voltage) C1102 (Low Voltage)	Battery Voltage out of Range (Low or Over Voltage)

DESCRIPTION

The voltage of the HECU power supply drops lower than or rises higher than the specified value.
If the voltage returns to the specified value, this code is no longer output.

⚠CAUTION

If battery voltage drops or rises during inspection, this code will be output as well. If the voltage returns to the standard value, the code is no longer output. Before carrying out the following inspection, check the battery level, and refill if necessary.

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DTC DETECTING CONDITION

DTC No	Detecting Condition	Possible Cause
C1101 (Over Voltage) C1102 (Low Voltage)	**Detecting Condition for Over Voltage:** 1. When Vign>17V is continued for 500msec. 2. When Vign>19V is continued for 49msec. 3. If the voltage recover normal operating range, the controller is reset. **Detecting Condition for Low Voltage:** 1. When Vign<9.4V is continued for 500msec. 2. When Vign>9.6V is continued for 500msec, the controller recovers to normal state. 3. During ABS control or standstill, detection voltage = 8.4V, recovery voltage = 8.6V. 4. When Vign<7.2V is continued for 28msec. 5. When Vign>7.5V is continued for 28msec, the controller recovers to state 1).	- An open or short in the wire - Faulty power supply circuit - Faulty HECU

FAILSAFE FUNCTION

Over voltage failure:

System down. both the ABS(,TCS) and the EBD function are inhibited and the ABS(,TCS) and the EBD warning lamps are activated. In this failure, the valve relay and all solenoids are prevented from being switched on.

Low voltage failure:

1. Outside the ABS control cycle : Inhibit the ABS(,TCS) control of front wheels and allow the ABS control of rear wheels, deactivating the motor, and the ABS(,TCS) warning lamp is switched on. When the voltage recover to the normal operating range, enable ABS function and ABS(,TCS) warning lamp is switched off and erase the error code.
2. Inside the ABS control cycle : Inhibit ABS control of the front wheels and allow ABS control of the rear wheels, deactivating the motor. The ABS(,TCS) warning lamp is directly switched on and the state keeps continuously. The error code is always stored.

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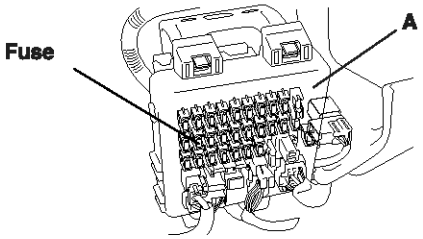
INSPECTION PROCEDURES

1 . CHECK FUSE (10A) FROM JUNCTION BLOCK.

Check continuity of fuse (10A) from passenger compartment junction block (A).

Is there continuity?



Yes

No	Check for short circuit in all the harness and components connected to fuse.

BJGE520A

2 . CHECK BATTERY POSITIVE VOLTAGE.

Is battery voltage within 10~14V?

Yes

No	Check and repair the charging system.

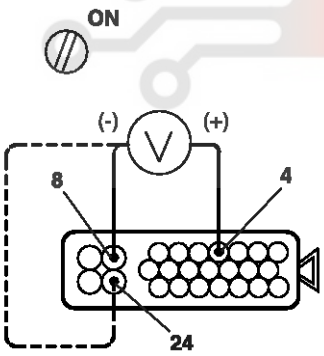
BJGE520B

3 . CHECK FOR VOLTAGE BETWEEN TERMINALS OF HECU HARNESS SIDE CONNECTOR.

1. Disconnect the connector from the ABS control module.
2. Turn the ignition switch ON.
3. Measure the voltage between terminals 4 and 8, 24 of the ABS control module harness side connector.

- **Specification: approximately B+**

Is the voltage within specification?



No

Yes	Check and replace the ABS control module.

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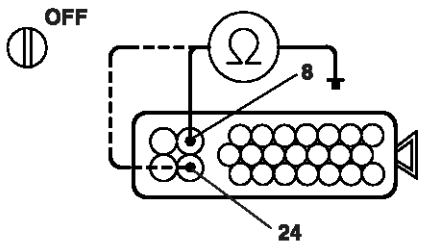
4 . CHECK THE RESISTANCE BETWEEN TERMINALS OF HECU CONNECTOR AND BODY GROUND.

Measure the resistance between terminals 8, 24 of ABS control module harness side connector and body ground.

- **Specification: 1Ω or less**

Is the resistance within specification?

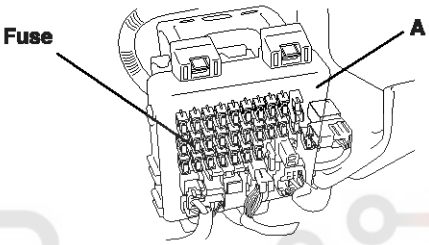


Yes	
No	Repair an open in the wire or faulty ground point.

BJGE520D

5 . CHECK FOR OPEN CIRCUIT BETWEEN TERMINAL OF HECU CONNECTOR AND FUSE.

Check for open circuit in harness and connector between terminal 4 of ABS control module harness side connector and fuse (10A) in the passenger compartment junction block (A).



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INSPECTION PROCEDURES FOR DIAGNOSTIC TROUBLE CODES

Battery Voltage out of Range

DTC	C1101 (Over Voltage) C1102 (Low Voltage)	Battery Voltage out of Range (Low or Over Voltage)

DESCRIPTION

The voltage of the HECU power supply drops lower than or rises higher than the specified value.
If the voltage returns to the specified value, this code is no longer output.

⚠CAUTION

If battery voltage drops or rises during inspection, this code will be output as well. If the voltage returns to the standard value, the code is no longer output. Before carrying out the following inspection, check the battery level, and refill if necessary.

DTC DETECTING CONDITION

DTC No	Detecting Condition	Possible Cause
C1101 (Over Voltage) C1102 (Low Voltage)	**Detecting Condition for Over Voltage:** 1. When Vign>17V is continued for 500msec. 2. When Vign>19V is continued for 49msec. 3. If the voltage recover normal operating range, the controller is reset. **Detecting Condition for Low Voltage:** 1. When Vign<9.4V is continued for 500msec. 2. When Vign>9.6V is continued for 500msec, the controller recovers to normal state. 3. During ABS control or standstill, detection voltage = 8.4V, recovery voltage = 8.6V. 4. When Vign<7.2V is continued for 28msec. 5. When Vign>7.5V is continued for 28msec, the controller recovers to state 1).	- An open or short in the wire - Faulty power supply circuit - Faulty HECU

FAILSAFE FUNCTION

Over voltage failure:
System down. both the ABS(,TCS) and the EBD function are inhibited and the ABS(,TCS) and the EBD warning lamps are activated. In this failure, the valve relay and all solenoids are prevented from being switched on.

Low voltage failure:

1. Outside the ABS control cycle : Inhibit the ABS(,TCS) control of front wheels and allow the ABS control of rear wheels, deactivating the motor, and the ABS(,TCS) warning lamp is switched on. When the voltage recover to the normal operating range, enable ABS function and ABS(,TCS) warning lamp is switched off and erase the error code.
2. Inside the ABS control cycle : Inhibit ABS control of the front wheels and allow ABS control of the rear wheels, deactivating the motor. The ABS(,TCS) warning lamp is directly switched on and the state keeps continuously. The error code is always stored.

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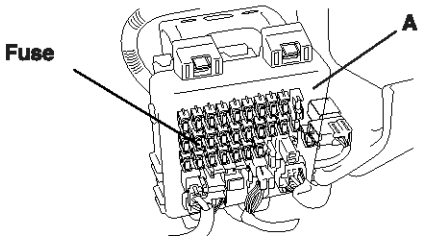
INSPECTION PROCEDURES

1 . CHECK FUSE (10A) FROM JUNCTION BLOCK.

Check continuity of fuse (10A) from passenger compartment junction block (A).

Is there continuity?



Yes

No	Check for short circuit in all the harness and components connected to fuse.

BJGE520A

2 . CHECK BATTERY POSITIVE VOLTAGE.

Is battery voltage within 10~14V?

Yes

No	Check and repair the charging system.

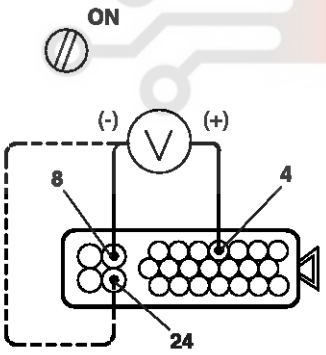
BJGE520B

3 . CHECK FOR VOLTAGE BETWEEN TERMINALS OF HECU HARNESS SIDE CONNECTOR.

1. Disconnect the connector from the ABS control module.
2. Turn the ignition switch ON.
3. Measure the voltage between terminals 4 and 8, 24 of the ABS control module harness side connector.

- **Specification: approximately B+**

Is the voltage within specification?



No

Yes	Check and replace the ABS control module.

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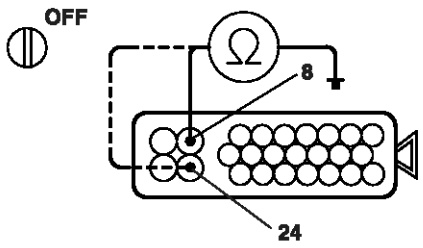
4 . CHECK THE RESISTANCE BETWEEN TERMINALS OF HECU CONNECTOR AND BODY GROUND.

Measure the resistance between terminals 8, 24 of ABS control module harness side connector and body ground.

- **Specification: 1Ω or less**

Is the resistance within specification?

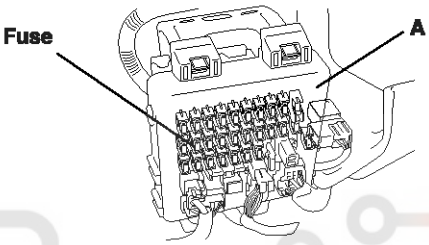


Yes	
No	Repair an open in the wire or faulty ground point.

BJGE520D

5 . CHECK FOR OPEN CIRCUIT BETWEEN TERMINAL OF HECU CONNECTOR AND FUSE.

Check for open circuit in harness and connector between terminal 4 of ABS control module harness side connector and fuse (10A) in the passenger compartment junction block (A).



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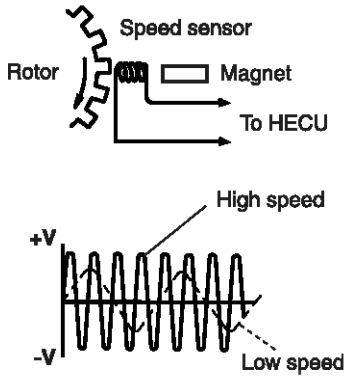
INSPECTION PROCEDURES FOR DIAGNOSTIC TROUBLE CODES

Wheel Speed Sensor Open or Short to Ground

DTC	C1200 (FL) C1203 (FR) C1206 (RL) C1209 (RR)	Wheel Speed Sensor Open or Short to Ground

DESCRIPTION

The wheel speed sensor detects wheel speed and sends the appropriate signals to the HECU. These signals are used to control of the ABS system. The front and rear rotors each have 44 serrations.
When the rotors rotate, the magnetic field emitted by the permanent magnet in the speed sensor generates an AC voltage.
Since the frequency of this AC voltage changes in direct proportion to the speed of the rotor, the frequency is used by HECU to detect the speed of each wheel.



BJGE521A

DTC No	Detecting Condition	Possible Cause

DTC DETECTING CONDITION

C1200 (FL) C1203 (FR) C1206 (RL) C1209 (RR)	The wheel velocity is below 7km/h and the offset voltage of the sensor is outside the permitted range. if this condition is continued for more than 140msec.	- An open or short in the wire - Faulty wheel speed sensor - Faulty HECU

FAILSAFE FUNCTION

Sensor failure outside the ABS control cycle:

1. Only one wheel failure
   Only the ABS(,TCS) function is inhibited. the ABS(,TCS) warning lamp is activated and the EBD warning lamp not activated.
2. More than two wheels failure
   System down. Both the ABS(,TCS) and the EBD function are inhibited and the ABS(,TCS) and the EBD warning lamps is activated. In this failure, the valve relay and all solenoids are prevented from being switched on.

Sensor failure inside the ABS control cycle:

1. One front wheel failure
   Inhibit the ABS control of the failed-wheel and maintain the ABS control of normal wheel.
   After the controller completes the ABS control, the ABS(,TCS) function is inhibited. the ABS(,TCS) warning lamp is activated and the EBD warning lamp not activated.
2. One rear wheel failure
   Inhibit ABS control of both front wheels and the pressure of both rear wheels is decreased.
   After the controller completes the ABS control, only the ABS(,TCS) function is inhibited. the ABS(,TCS) warning lamp is activated and the EBD warning lamp not activated.
3. More than two wheels failure.
   System down. Both the ABS(,TCS) and the EBD function are inhibited and the ABS(,TCS) and the EBD warning lamps is activated. In this failure, the valve relay and all solenoids are prevented from being switched on.

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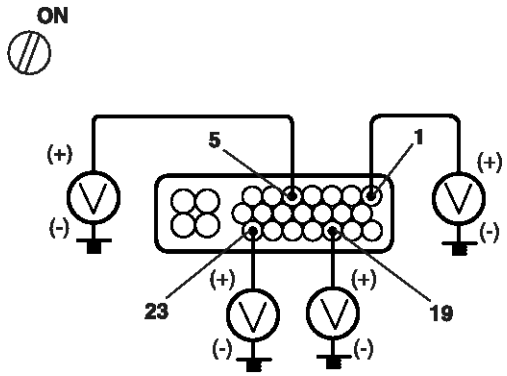
INSPECTION PROCEDURES

1. PROBLEM VERIFICATION

1. Disconnect the ABS control module connector.
2. Start the engine.
3. Measure the voltage between the appropriate wheel sensor(+) circuit terminal and body ground (see table).



DTC	Terminal
C1200 (Front - left)	1
C1203 (Front - right)	19
C1206 (Rear - left)	5
C1209 (Rear - right)	23

Is there 2V or more?

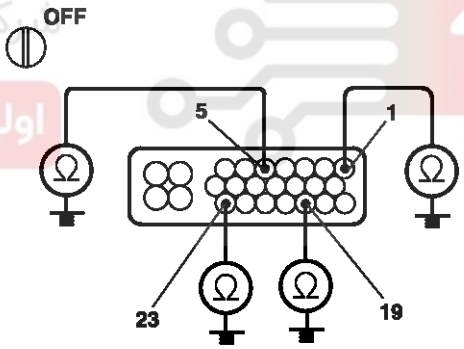
No

Yes	Repair short to power in the (+) circuit wire between the ABS control module and the appropriate wheel sensor.

BJGE521B

2. CHECK CIRCUIT FOR SHORT TO GROUND.

Check for continuity between the appropriate wheel sensor(+) circuit terminal and body ground (see table).



DTC	Terminal
C1200 (Front - left)	1
C1203 (Front - right)	19
C1206 (Rear - left)	5
C1209 (Rear - right)	23

Is there continuity?

Yes	Disconnect the harness 2P connector from the appropriate wheel sensor, then check for continuity between the (+) and (-) terminals of the harness and body ground. **Is there continuity?**

Yes

No	Replace the wheel sensor.

No

Repair short to body ground in the (+) or (-) circuit wire between the ABS control module and the wheel sensor.

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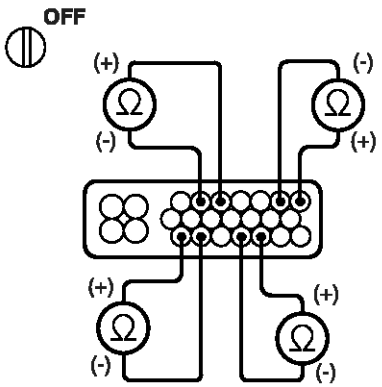
3. CHECK THE RESISTANCE BETWEEN TERMINALS OF HECU.

Check the resistance between the appropriate wheel sensor (+) and (-) circuit terminals. (see table)

DTC	Terminal	
	(+) side	(-) side
C1200 (Front - left)	1	2
C1203 (Front - right)	19	20
C1206 (Rear - left)	5	6
C1209 (Rear - right)	23	22



Is the resistance within 1,275~1,495Ω?

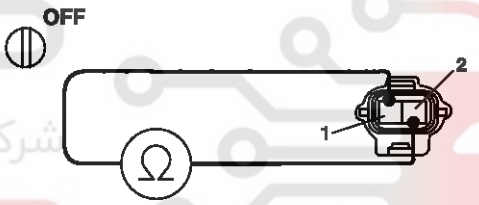
No

Yes	Check for loose ABS control module connectors. If necessary, substitute a known-good ABS control module and recheck.

BJGE521D

4. CHECK THE RESISTANCE BETWEEN TERMINALS OF WHEEL SENSOR

Disconnect the harness 2P connector from the appropriate wheel sensor, and check the resistance between the (+) and (-) terminals of the wheel sensor.



Is the resistance within 1,275~1,495Ω?

Yes

No	Replace the wheel sensor.

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5 . REPAIR AN OPEN OR SHORT IN THE WIRE.

Repair open in the (+) or (-) circuit wire, or short between the (+) circuit wire and the (-) circuit wire between the ABS control module and the wheel sensor.

INSPECTION PROCEDURES FOR DIAGNOSTIC TROUBLE CODES

Wheel Speed Sensor Signal Malfunction

DTC	**C1201 (FL) C1204 (FR) C1207 (RL) C1210 (RR)**	**Wheel Speed Sensor Signal Malfunction (Speed jump or damaged exciter)**

DTC DETECTING CONDITION

DTC No	Detecting Condition	Possible Cause
C1201 (FL) C1204 (FR) C1207 (RL) C1210 (RR)	**Detecting Condition for Speed Jump:** This monitoring is performed for the period that the velocity of each wheel exceeds 1.24mph(2km/h). 1. Controller counts the number of the wheel acceleration of 100 g[15.53mph(25km/h) for 7ms]. When the numbers at one wheel exceed 56 times, or When the numbers at more two wheels exceed 5 times, controller recognize the failure. 2. Controller counts the number of the wheel acceleration of 40g [6.21mph(10km/h) for 7ms]. When the numbers at one wheel exceed 126 times, or when the numbers at more two wheels exceed 20 times, controller recognize the failure. 3. Controller counts the number of the wheel deceleration of -100g[-15.53mph(-25km/h) for 7ms]. When the numbers at each wheel exceed 56 times, controller recognize the failure. 4. The wheel deceleration of -100g[-15.53mph(-25km/h) for 7ms] causes the controller to start monitoring this failure and to comparethe wheel velocity with the vehicle velocity from next cycle. When its difference of -100g is continued for more than 140msec, controller recognize the failure. 5. In case that any sensor failure at other wheel was already detected, When the numbers of 100g at each wheel exceed 5 times, or when the numbers of 40g at each wheel exceed 20 times, controller recognize the failure. **Detecting Condition for Damaged Exciter:** 1. Max. wheel velocity exceeds 12.4mph(20km/h) and the wheel velocity is 40% of max. wheel velocity. If this condition is lasted for 2 minutes. 2. Max. wheel velocity exceeds 24.9mph(40km/h) and the wheel velocity is 60% of max. wheel velocity. If this condition is lasted for 2 minutes.	- Improper installation of wheel speed sensor - An open or short in the wire - Faulty wheel speed sensor - Faulty rotor or wheel bearing - Faulty HECU

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FAILSAFE FUNCTION

Sensor failure outside the ABS control cycle:

1. Only one wheel failure
   Only the ABS(,TCS) function is inhibited. the ABS(,TCS) warning lamp is activated and the EBD warning lamp does not activated.
2. More than two wheels failure
   System down. Both the ABS(,TCS) and the EBD function are inhibited and the ABS(,TCS) and the EBD warning lamps are activated. In this failure, the valve relay and all solenoids are prevented from being switched on.

Sensor failure inside the ABS control cycle:

1. One front wheel failure
   Inhibit the ABS control of the failed-wheel and maintain the ABS control of normal wheel.
   After the controller completes the ABS control, the ABS(,TCS) function is inhibited. The ABS(,TCS) warning lamp is activated and the EBD warning lamp not activated.
2. One rear wheel failure
   Inhibit ABS control of both front wheels and the pressure of both rear wheels is decreased.
   After the controller completes the ABS control, Only the ABS(,TCS) function is inhibited. The ABS(,TCS) warning lamp is activated and the EBD warning lamp not activated.
3. More than two wheels failure.
   System down. Both the ABS(,TCS) and the EBD function are inhibited and the ABS(,TCS) and the EBD warning lamps are activated. In this failure, the valve relay and all solenoids are prevented from being switched on.

INSPECTION PROCEDURES

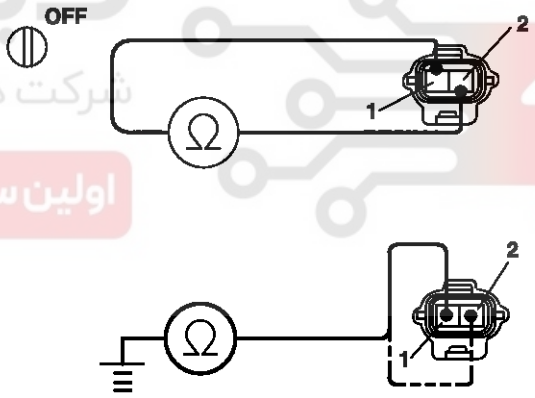
1 . CHECK WHEEL SPEED SENSOR

1. Disconnect the wheel speed sensor connector (2P).
2. Measure the resistance between terminals 1 and 2 of the wheel speed sensor connector.

- **Specification: 1,275~1,495Ω**

3. Measure the resistance between terminals 1 and 2 of the wheel speed sensor connector and body ground.

- **Specification: 1MΩ or higher**



Is the resistance within specification?

Yes	No	Replace the wheel speed sensor.

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2 . CHECK FOR OPEN AND SHORT CIRCUIT

Check for open and short circuit in the harness and connector between each wheel speed sensor and ABS control module.

OK	NG	Repair or replace harness or connector.

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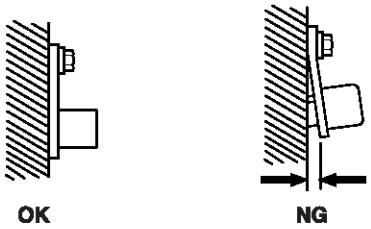
BJGE522B

3 . CHECK WHEEL SPEED SENSOR INSTALLATION

Visually check for appropriate wheel speed sensor and rotor installation.

Note)
The mounting bolt shall be tightened properly and there is no clearance is allowed between the sensor and front steering knuckle or rear axle carrier.



OK

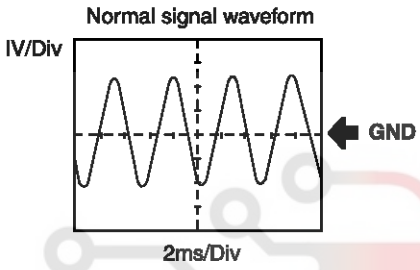
NG	Repair or replace the wheel speed sensor.

BJGE522C

4 . CHECK WHEEL SPEED SENSOR AND SENSOR ROTOR

1. Disconnect the connector from the ABS control module.
2. Rotate the wheel to be measured approximately 1/2 to 1 rotation per second, and check the output voltage and the signal waveform using oscilloscope.

- **Specification: 130mVp-p or more.**



NG

OK	Check and replace the ABS control module.

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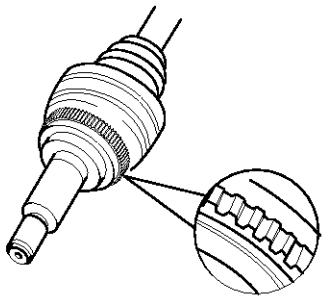
5 . CHECK SENSOR ROTOR AND SENSOR TIP

1. Remove the front drive shaft and the rear axle hub.
2. Check the sensor rotor serrations.
   Check if there are no scratches, missing teeth or foreign objects.
3. Remove the front and rear wheel speed sensors.
4. Check if there are no scratches or foreign objects on the sensor tip.



OK

NG	Replace the sensor rotor or wheel speed sensor.

Erase the DTC, and test-drive the vehicle.
If the ABS warning lamp comes on and the same DTC is indicated, replace the ABS control module.

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INSPECTION PROCEDURES FOR DIAGNOSTIC TROUBLE CODES

Wheel Speed Sensor Signal Malfunction

DTC	C1202 (FL) C1205 (FR) C1208 (RL) C1211 (RR)	Wheel Speed Sensor Signal Malfunction (Air-gap error or wrong excite)

DTC DETECTING CONDITION

DTC No	Detecting Condition	Possible Cause
C1202 (FL) C1205 (FR) C1208 (RL) C1211 (RR)	**Detecting Condition for Large Air-Gap:** This monitoring is performed for the period that the minimum velocity rises from 1.24mph(2km/h) to 6.21mph(10km/h). 1. When the minimum wheel velocity is 1.24mph(2km/h) and the velocity of other wheels exceed 6.21mph(10km/h) with the acceleration of < 0.4g, the controller start comparing the velocity of other wheels except the min. wheel. if their differencebelow 2.49mph(4km/h) is continued for 154msec. Otherwise, if their difference beyond 2.49mph(4km/h) or > 0.4g is continued for 2 minutes. 2. In < 0.4g, when the velocity of more two wheels is 1.24mph(2 km/h) and the max. wheel velocity exceeds 6.21mph(10km/h) , the condition is continued for 20 sec. Otherwise, In >0.4g, the condition is 2 minutes. 3. After velocity of 4 wheel exceeds 6.21mph(10km/h), when velocity of 1 wheel or 2 wheel is 1.24mph(2km/h) and difference of other 2 wheel velocity is less than 4km/h under that those velocity is more than 6.21mph(10km/h), if that conditions are continued for 12 seconds. **Detecting Condition for Long Term ABS mode:** 1. During the ABS control cycle, if the wheel velocity of 1.24mph (2km/h) is lasted for more than 12sec. 2. If the ABS control cycle is continued for more than 36sec.	- Improper installation of wheel speed sensor - An open or short in the wire - Faulty wheel speed sensor - Faulty rotor or wheel bearing - Faulty HECU

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FAILSAFE FUNCTION

Sensor failure outside the ABS control cycle:

1. Only one wheel failure
   Only the ABS(,TCS) function is inhibited. The ABS(,TCS) warning lamp is activated and the EBD warning lamp not activated.
2. More than two wheels failure
   System down. Both the ABS(,TCS) and the EBD function are inhibited and the ABS(,TCS) and the EBD warning lamps are activated. In this failure, the valve relay and all solenoids are prevented from being switched on.

Sensor failure inside the ABS control cycle:

1. One front wheel failure
   Inhibit the ABS control of the failed-wheel and maintain the ABS control of normal wheel.
   After the controller completes the ABS control, the ABS(,TCS) function is inhibited. The ABS(,TCS) warning lamp is activated and the EBD warning lamp not activated.
2. One rear wheel failure
   Inhibit ABS control of both front wheels and the pressure of both rear wheels is decreased.
   After the controller completes the ABS control, Only the ABS(,TCS) function is inhibited. The ABS(,TCS) warning lamp is activated and the EBD warning lamp not activated.
3. More than two wheels failure.
   System down. Both the ABS(,TCS) and the EBD function are inhibited and the ABS(,TCS) and the EBD warning lamps are activated. In this failure, the valve relay and all solenoids are prevented from being switched on.

INSPECTION PROCEDURES

1. CHECK WHEEL SPEED SENSOR INSTALLATION

Visually check for appropriate wheel speed sensor and rotor installation (see table).

DTC	Appropriate wheel sensor
C1202	Front - left wheel sensor
C1205	Front - right wheel sensor
C1208	Rear- left wheel sensor
C1211	Rear- right wheel sensor

Are they installed correctly?

Yes	No	Reinstall or replace the appropriate wheel speed sensor.

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2. CHECK AIR GAP BETWEEN WHEEL SPEED SENSOR AND TONE WHEEL.

- **Specification**
  - Front: 0.2~1.3 mm (0.0079~0.0512 in.)
  - Rear: 0.2~1.3 mm (0.0079~0.0512 in.)

Is the air gap within specification?

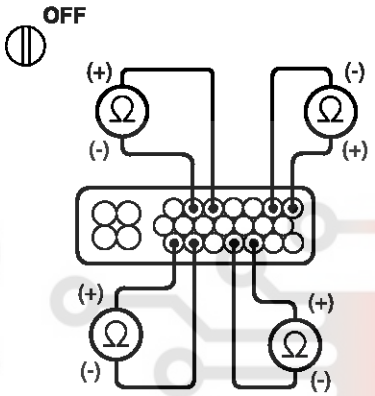
Yes	No	Reinstall or replace the appropriate wheel speed sensor.

BJGE523B

3. CHECK THE RESISTANCE BETWEEN TERMINALS OF HECU.

1. Disconnect the ABS control module connector.
2. Measure the resistance between the appropriate wheel speed sensor(+) and (-) circuit terminals (see table).

DTC	Appropriate Terminal	
	(+) side	(-) side
C1202 (Front - left)	1	2
C1205 (Front - right)	19	20
C1208 (Rear - left)	5	6
C1211 (Rear - right)	23	22



Is the resistance within 1,275~1,495Ω?

Yes	No	Repair an open or short in the wire between the ABS control module and the wheel speed sensor.

Erase the DTC, and test-drive the vehicle.
If the ABS warning lamp comes on and the same DTC is indicated, replace the ABS control module.

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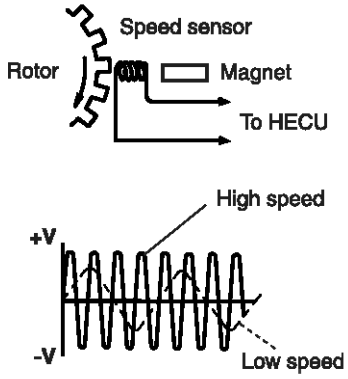
INSPECTION PROCEDURES FOR DIAGNOSTIC TROUBLE CODES

Wheel Speed Sensor Open or Short to Ground

DTC	C1200 (FL) C1203 (FR) C1206 (RL) C1209 (RR)	Wheel Speed Sensor Open or Short to Ground

DESCRIPTION

The wheel speed sensor detects wheel speed and sends the appropriate signals to the HECU. These signals are used to control of the ABS system. The front and rear rotors each have 44 serrations.
When the rotors rotate, the magnetic field emitted by the permanent magnet in the speed sensor generates an AC voltage.
Since the frequency of this AC voltage changes in direct proportion to the speed of the rotor, the frequency is used by HECU to detect the speed of each wheel.



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DTC DETECTING CONDITION

DTC No	Detecting Condition	Possible Cause
C1200 (FL) C1203 (FR) C1206 (RL) C1209 (RR)	The wheel velocity is below 7km/h and the offset voltage of the sensor is outside the permitted range. if this condition is continued for more than 140msec.	- An open or short in the wire - Faulty wheel speed sensor - Faulty HECU

FAILSAFE FUNCTION

Sensor failure outside the ABS control cycle:

1. Only one wheel failure
   Only the ABS(,TCS) function is inhibited. the ABS(,TCS) warning lamp is activated and the EBD warning lamp not activated.
2. More than two wheels failure
   System down. Both the ABS(,TCS) and the EBD function are inhibited and the ABS(,TCS) and the EBD warning lamps is activated. In this failure, the valve relay and all solenoids are prevented from being switched on.

Sensor failure inside the ABS control cycle:

1. One front wheel failure
   Inhibit the ABS control of the failed-wheel and maintain the ABS control of normal wheel.
   After the controller completes the ABS control, the ABS(,TCS) function is inhibited. the ABS(,TCS) warning lamp is activated and the EBD warning lamp not activated.
2. One rear wheel failure
   Inhibit ABS control of both front wheels and the pressure of both rear wheels is decreased.
   After the controller completes the ABS control, only the ABS(,TCS) function is inhibited. the ABS(,TCS) warning lamp is activated and the EBD warning lamp not activated.
3. More than two wheels failure.
   System down. Both the ABS(,TCS) and the EBD function are inhibited and the ABS(,TCS) and the EBD warning lamps is activated. In this failure, the valve relay and all solenoids are prevented from being switched on.

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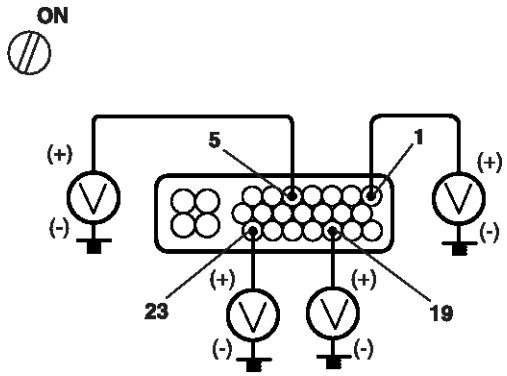
INSPECTION PROCEDURES

1. PROBLEM VERIFICATION

1. Disconnect the ABS control module connector.
2. Start the engine.
3. Measure the voltage between the appropriate wheel sensor(+) circuit terminal and body ground (see table).



DTC	Terminal
C1200 (Front - left)	1
C1203 (Front - right)	19
C1206 (Rear - left)	5
C1209 (Rear - right)	23

Is there 2V or more?

No	Yes	Repair short to power in the (+) circuit wire between the ABS control module and the appropriate wheel sensor.

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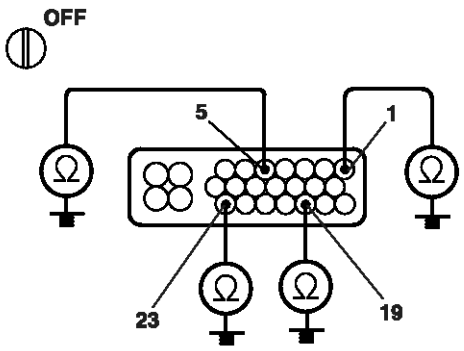
2. CHECK CIRCUIT FOR SHORT TO GROUND.

Check for continuity between the appropriate wheel sensor(+) circuit terminal and body ground (see table).

DTC	Terminal
C1200 (Front - left)	1
C1203 (Front - right)	19
C1206 (Rear - left)	5
C1209 (Rear - right)	23



Is there continuity?

Yes	Disconnect the harness 2P connector from the appropriate wheel sensor, then check for continuity between the (+) and (-) terminals of the harness and body ground. **Is there continuity?**

Yes

No	Replace the wheel sensor.

No

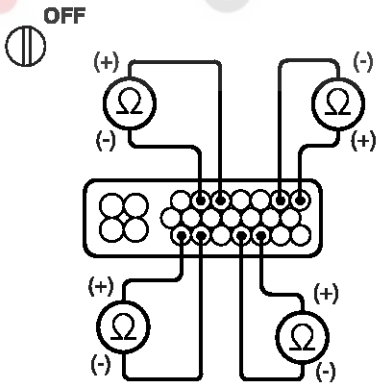
Repair short to body ground in the (+) or (-) circuit wire between the ABS control module and the wheel sensor.

BJGE521C

3. CHECK THE RESISTANCE BETWEEN TERMINALS OF HECU.

Check the resistance between the appropriate wheel sensor (+) and (-) circuit terminals. (see table)

DTC	Terminal	
	(+) side	(-) side
C1200 (Front - left)	1	2
C1203 (Front - right)	19	20
C1206 (Rear - left)	5	6
C1209 (Rear - right)	23	22



Is the resistance within 1,275~1,495Ω?

No

Yes	Check for loose ABS control module connectors. If necessary, substitute a known-good ABS control module and recheck.

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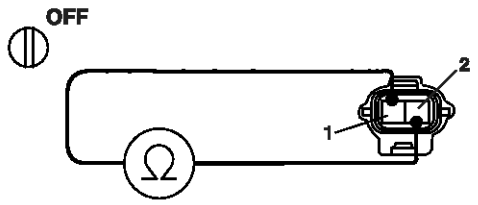
4 . CHECK THE RESISTANCE BETWEEN TERMINALS OF WHEEL SENSOR

Disconnect the harness 2P connector from the appropriate wheel sensor, and check the resistance between the (+) and (-) terminals of the wheel sensor.



Is the resistance within 1,275~1,495Ω?

Yes	No	Replace the wheel sensor.

BJGE521E

5 . REPAIR AN OPEN OR SHORT IN THE WIRE.

Repair open in the (+) or (-) circuit wire, or short between the (+) circuit wire and the (-) circuit wire between the ABS control module and the wheel sensor.

BJGE521F

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INSPECTION PROCEDURES FOR DIAGNOSTIC TROUBLE CODES

Wheel Speed Sensor Signal Malfunction

DTC	C1201 (FL) C1204 (FR) C1207 (RL) C1210 (RR)	Wheel Speed Sensor Signal Malfunction (Speed jump or damaged exciter)

DTC DETECTING CONDITION

DTC No	Detecting Condition	Possible Cause
C1201 (FL) C1204 (FR) C1207 (RL) C1210 (RR)	**Detecting Condition for Speed Jump:** This monitoring is performed for the period that the velocity of each wheel exceeds 1.24mph(2km/h). 1. Controller counts the number of the wheel acceleration of 100 g[15.53mph(25km/h) for 7ms]. When the numbers at one wheel exceed 56 times, or When the numbers at more two wheels exceed 5 times, controller recognize the failure. 2. Controller counts the number of the wheel acceleration of 40g [6.21mph(10km/h) for 7ms]. When the numbers at one wheel exceed 126 times, or when the numbers at more two wheels exceed 20 times, controller recognize the failure. 3. Controller counts the number of the wheel deceleration of -100g[-15.53mph(-25km/h) for 7ms]. When the numbers at each wheel exceed 56 times, controller recognize the failure. 4. The wheel deceleration of -100g[-15.53mph(-25km/h) for 7ms] causes the controller to start monitoring this failure and to comparethe wheel velocity with the vehicle velocity from next cycle. When its difference of -100g is continued for more than 140msec, controller recognize the failure. 5. In case that any sensor failure at other wheel was already detected, When the numbers of 100g at each wheel exceed 5 times, or when the numbers of 40g at each wheel exceed 20 times, controller recognize the failure. **Detecting Condition for Damaged Exciter:** 1. Max. wheel velocity exceeds 12.4mph(20km/h) and the wheel velocity is 40% of max. wheel velocity. If this condition is lasted for 2 minutes. 2. Max. wheel velocity exceeds 24.9mph(40km/h) and the wheel velocity is 60% of max. wheel velocity. If this condition is lasted for 2 minutes.	- Improper installation of wheel speed sensor - An open or short in the wire - Faulty wheel speed sensor - Faulty rotor or wheel bearing - Faulty HECU

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FAILSAFE FUNCTION

Sensor failure outside the ABS control cycle:

1. Only one wheel failure
   Only the ABS(,TCS) function is inhibited. the ABS(,TCS) warning lamp is activated and the EBD warning lamp does not activated.
2. More than two wheels failure
   System down. Both the ABS(,TCS) and the EBD function are inhibited and the ABS(,TCS) and the EBD warning lamps are activated. In this failure, the valve relay and all solenoids are prevented from being switched on.

Sensor failure inside the ABS control cycle:

1. One front wheel failure
   Inhibit the ABS control of the failed-wheel and maintain the ABS control of normal wheel.
   After the controller completes the ABS control, the ABS(,TCS) function is inhibited. The ABS(,TCS) warning lamp is activated and the EBD warning lamp not activated.
2. One rear wheel failure
   Inhibit ABS control of both front wheels and the pressure of both rear wheels is decreased.
   After the controller completes the ABS control, Only the ABS(,TCS) function is inhibited. The ABS(,TCS) warning lamp is activated and the EBD warning lamp not activated.
3. More than two wheels failure.
   System down. Both the ABS(,TCS) and the EBD function are inhibited and the ABS(,TCS) and the EBD warning lamps are activated. In this failure, the valve relay and all solenoids are prevented from being switched on.

INSPECTION PROCEDURES

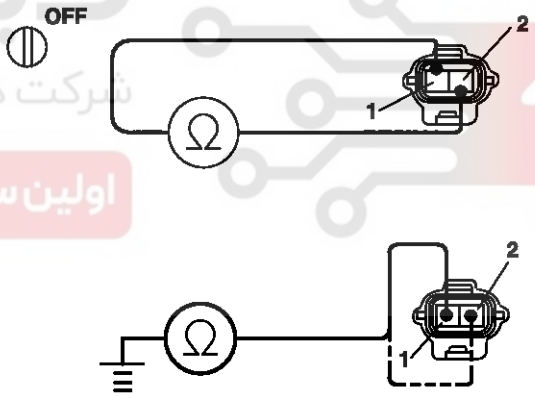
1 . CHECK WHEEL SPEED SENSOR

1. Disconnect the wheel speed sensor connector (2P).
2. Measure the resistance between terminals 1 and 2 of the wheel speed sensor connector.

- **Specification: 1,275~1,495Ω**

3. Measure the resistance between terminals 1 and 2 of the wheel speed sensor connector and body ground.

- **Specification: 1MΩ or higher**



Is the resistance within specification?

Yes	No	Replace the wheel speed sensor.

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2 . CHECK FOR OPEN AND SHORT CIRCUIT

Check for open and short circuit in the harness and connector between each wheel speed sensor and ABS control module.

OK	NG	Repair or replace harness or connector.

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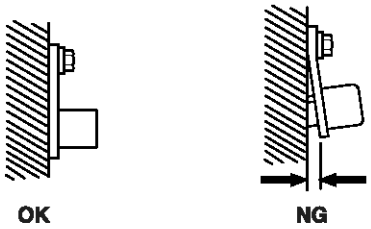
3 . CHECK WHEEL SPEED SENSOR INSTALLATION

Visually check for appropriate wheel speed sensor and rotor installation.

Note)
The mounting bolt shall be tightened properly and there is no clearance is allowed between the sensor and front steering knuckle or rear axle carrier.



OK

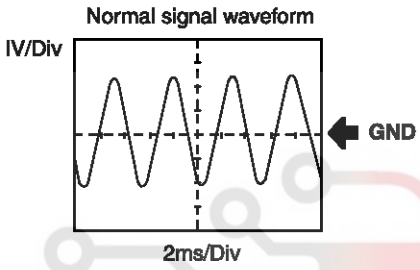
NG	Repair or replace the wheel speed sensor.

BJGE522C

4 . CHECK WHEEL SPEED SENSOR AND SENSOR ROTOR

1. Disconnect the connector from the ABS control module.
2. Rotate the wheel to be measured approximately 1/2 to 1 rotation per second, and check the output voltage and the signal waveform using oscilloscope.

- **Specification: 130mVp-p or more.**



NG

OK	Check and replace the ABS control module.

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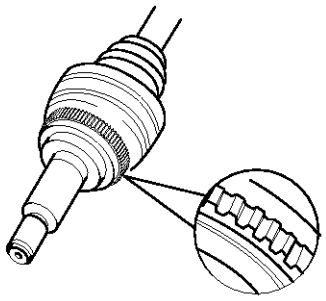
5 . CHECK SENSOR ROTOR AND SENSOR TIP

1. Remove the front drive shaft and the rear axle hub.
2. Check the sensor rotor serrations.
   Check if there are no scratches, missing teeth or foreign objects.
3. Remove the front and rear wheel speed sensors.
4. Check if there are no scratches or foreign objects on the sensor tip.



OK

NG	Replace the sensor rotor or wheel speed sensor.

Erase the DTC, and test-drive the vehicle.
If the ABS warning lamp comes on and the same DTC is indicated, replace the ABS control module.

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INSPECTION PROCEDURES FOR DIAGNOSTIC TROUBLE CODES

Wheel Speed Sensor Signal Malfunction

DTC	**C1202 (FL) C1205 (FR) C1208 (RL) C1211 (RR)**	**Wheel Speed Sensor Signal Malfunction (Air-gap error or wrong excite)**

DTC DETECTING CONDITION

DTC No	Detecting Condition	Possible Cause
C1202 (FL) C1205 (FR) C1208 (RL) C1211 (RR)	**Detecting Condition for Large Air-Gap:** This monitoring is performed for the period that the minimum velocity rises from 1.24mph(2km/h) to 6.21mph(10km/h). 1. When the minimum wheel velocity is 1.24mph(2km/h) and the velocity of other wheels exceed 6.21mph(10km/h) with the acceleration of < 0.4g, the controller start comparing the velocity of other wheels except the min. wheel. if their differencebelow 2.49mph(4km/h) is continued for 154msec. Otherwise, if their difference beyond 2.49mph(4km/h) or > 0.4g is continued for 2 minutes. 2. In < 0.4g, when the velocity of more two wheels is 1.24mph(2km/h) and the max. wheel velocity exceeds 6.21mph(10km/h), the condition is continued for 20 sec. Otherwise, In >0.4g, the condition is 2 minutes. 3. After velocity of 4 wheel exceeds 6.21mph(10km/h), when velocity of 1 wheel or 2 wheel is 1.24mph(2km/h) and difference of other 2 wheel velocity is less than 4km/h under that those velocity is more than 6.21mph(10km/h), if that conditions are continued for 12 seconds. **Detecting Condition for Long Term ABS mode:** 1. During the ABS control cycle, if the wheel velocity of 1.24mph (2km/h) is lasted for more than 12sec. 2. If the ABS control cycle is continued for more than 36sec.	- Improper installation of wheel speed sensor - An open or short in the wire - Faulty wheel speed sensor - Faulty rotor or wheel bearing - Faulty HECU

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FAILSAFE FUNCTION

Sensor failure outside the ABS control cycle:

1. Only one wheel failure
   Only the ABS(,TCS) function is inhibited. The ABS(,TCS) warning lamp is activated and the EBD warning lamp not activated.
2. More than two wheels failure
   System down. Both the ABS(,TCS) and the EBD function are inhibited and the ABS(,TCS) and the EBD warning lamps are activated. In this failure, the valve relay and all solenoids are prevented from being switched on.

Sensor failure inside the ABS control cycle:

1. One front wheel failure
   Inhibit the ABS control of the failed-wheel and maintain the ABS control of normal wheel.
   After the controller completes the ABS control, the ABS(,TCS) function is inhibited. The ABS(,TCS) warning lamp is activated and the EBD warning lamp not activated.
2. One rear wheel failure
   Inhibit ABS control of both front wheels and the pressure of both rear wheels is decreased.
   After the controller completes the ABS control, Only the ABS(,TCS) function is inhibited. The ABS(,TCS) warning lamp is activated and the EBD warning lamp not activated.
3. More than two wheels failure.
   System down. Both the ABS(,TCS) and the EBD function are inhibited and the ABS(,TCS) and the EBD warning lamps are activated. In this failure, the valve relay and all solenoids are prevented from being switched on.

INSPECTION PROCEDURES

1. CHECK WHEEL SPEED SENSOR INSTALLATION

Visually check for appropriate wheel speed sensor and rotor installation (see table).

DTC	Appropriate wheel sensor
C1202	Front - left wheel sensor
C1205	Front - right wheel sensor
C1208	Rear- left wheel sensor
C1211	Rear- right wheel sensor

Are they installed correctly?

Yes	No	Reinstall or replace the appropriate wheel speed sensor.

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2. CHECK AIR GAP BETWEEN WHEEL SPEED SENSOR AND TONE WHEEL.

- **Specification**
  - Front: 0.2~1.3 mm (0.0079~0.0512 in.)
  - Rear: 0.2~1.3 mm (0.0079~0.0512 in.)

Is the air gap within specification?

Yes	No	Reinstall or replace the appropriate wheel speed sensor.

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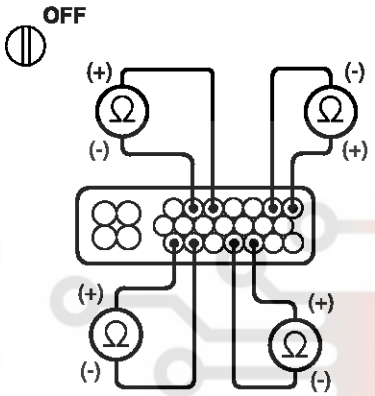
3. CHECK THE RESISTANCE BETWEEN TERMINALS OF HECU.

1. Disconnect the ABS control module connector.
2. Measure the resistance between the appropriate wheel speed sensor(+) and (-) circuit terminals (see table).

DTC	Appropriate Terminal	
	(+) side	(-) side
C1202 (Front - left)	1	2
C1205 (Front - right)	19	20
C1208 (Rear - left)	5	6
C1211 (Rear - right)	23	22



Is the resistance within 1,275~1,495Ω?

Yes	No	Repair an open or short in the wire between the ABS control module and the wheel speed sensor.

Erase the DTC, and test-drive the vehicle.
If the ABS warning lamp comes on and the same DTC is indicated, replace the ABS control module.

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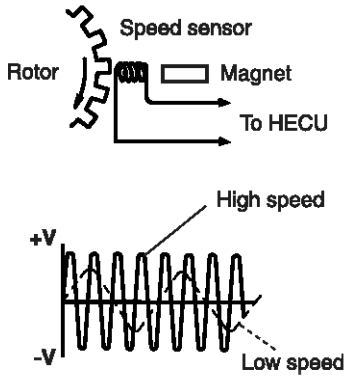
INSPECTION PROCEDURES FOR DIAGNOSTIC TROUBLE CODES

Wheel Speed Sensor Open or Short to Ground

DTC	C1200 (FL) C1203 (FR) C1206 (RL) C1209 (RR)	Wheel Speed Sensor Open or Short to Ground

DESCRIPTION

The wheel speed sensor detects wheel speed and sends the appropriate signals to the HECU. These signals are used to control of the ABS system. The front and rear rotors each have 44 serrations.
When the rotors rotate, the magnetic field emitted by the permanent magnet in the speed sensor generates an AC voltage.
Since the frequency of this AC voltage changes in direct proportion to the speed of the rotor, the frequency is used by HECU to detect the speed of each wheel.



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DTC DETECTING CONDITION

DTC No	Detecting Condition	Possible Cause
C1200 (FL) C1203 (FR) C1206 (RL) C1209 (RR)	The wheel velocity is below 7km/h and the offset voltage of the sensor is outside the permitted range. if this condition is continued for more than 140msec.	- An open or short in the wire - Faulty wheel speed sensor - Faulty HECU

FAILSAFE FUNCTION

Sensor failure outside the ABS control cycle:

1. Only one wheel failure
   Only the ABS(,TCS) function is inhibited. the ABS(,TCS) warning lamp is activated and the EBD warning lamp not activated.
2. More than two wheels failure
   System down. Both the ABS(,TCS) and the EBD function are inhibited and the ABS(,TCS) and the EBD warning lamps is activated. In this failure, the valve relay and all solenoids are prevented from being switched on.

Sensor failure inside the ABS control cycle:

1. One front wheel failure
   Inhibit the ABS control of the failed-wheel and maintain the ABS control of normal wheel.
   After the controller completes the ABS control, the ABS(,TCS) function is inhibited. the ABS(,TCS) warning lamp is activated and the EBD warning lamp not activated.
2. One rear wheel failure
   Inhibit ABS control of both front wheels and the pressure of both rear wheels is decreased.
   After the controller completes the ABS control, only the ABS(,TCS) function is inhibited. the ABS(,TCS) warning lamp is activated and the EBD warning lamp not activated.
3. More than two wheels failure.
   System down. Both the ABS(,TCS) and the EBD function are inhibited and the ABS(,TCS) and the EBD warning lamps is activated. In this failure, the valve relay and all solenoids are prevented from being switched on.

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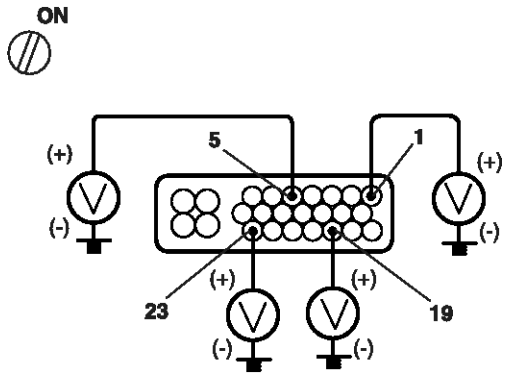
INSPECTION PROCEDURES

1. PROBLEM VERIFICATION

1. Disconnect the ABS control module connector.
2. Start the engine.
3. Measure the voltage between the appropriate wheel sensor(+) circuit terminal and body ground (see table).

DTC	Terminal
C1200 (Front - left)	1
C1203 (Front - right)	19
C1206 (Rear - left)	5
C1209 (Rear - right)	23



Is there 2V or more?

No

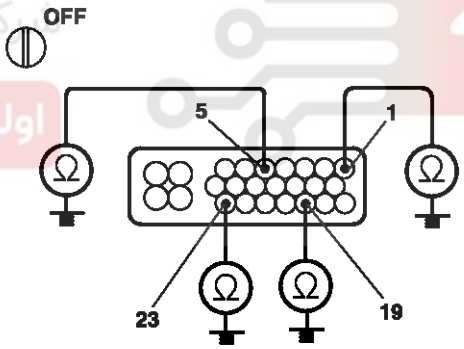
Yes	Repair short to power in the (+) circuit wire between the ABS control module and the appropriate wheel sensor.

BJGE521B

2. CHECK CIRCUIT FOR SHORT TO GROUND.

Check for continuity between the appropriate wheel sensor(+) circuit terminal and body ground (see table).

DTC	Terminal
C1200 (Front - left)	1
C1203 (Front - right)	19
C1206 (Rear - left)	5
C1209 (Rear - right)	23



Is there continuity?

Yes	Disconnect the harness 2P connector from the appropriate wheel sensor, then check for continuity between the (+) and (-) terminals of the harness and body ground. **Is there continuity?**

Yes

No	Replace the wheel sensor.

No

Repair short to body ground in the (+) or (-) circuit wire between the ABS control module and the wheel sensor.

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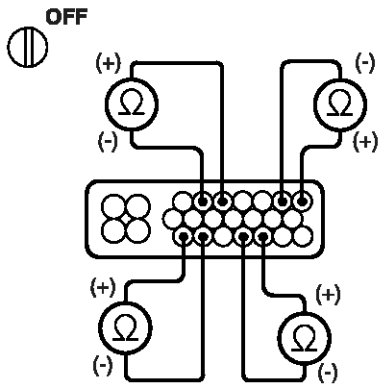
3. CHECK THE RESISTANCE BETWEEN TERMINALS OF HECU.

Check the resistance between the appropriate wheel sensor (+) and (-) circuit terminals. (see table)

DTC	Terminal	
	(+) side	(-) side
C1200 (Front - left)	1	2
C1203 (Front - right)	19	20
C1206 (Rear - left)	5	6
C1209 (Rear - right)	23	22



Is the resistance within 1,275~1,495Ω?

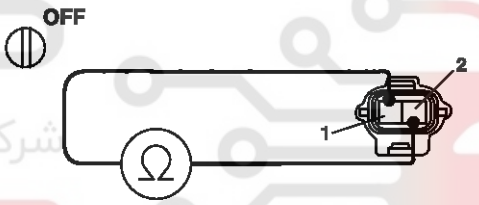
No

Yes	Check for loose ABS control module connectors. If necessary, substitute a known-good ABS control module and recheck.

BJGE521D

4. CHECK THE RESISTANCE BETWEEN TERMINALS OF WHEEL SENSOR

Disconnect the harness 2P connector from the appropriate wheel sensor, and check the resistance between the (+) and (-) terminals of the wheel sensor.



Is the resistance within 1,275~1,495Ω?

Yes

No	Replace the wheel sensor.

BJGE521E

5. REPAIR AN OPEN OR SHORT IN THE WIRE.

Repair open in the (+) or (-) circuit wire, or short between the (+) circuit wire and the (-) circuit wire between the ABS control module and the wheel sensor.

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INSPECTION PROCEDURES FOR DIAGNOSTIC TROUBLE CODES

Wheel Speed Sensor Signal Malfunction

DTC	C1201 (FL) C1204 (FR) C1207 (RL) C1210 (RR)	Wheel Speed Sensor Signal Malfunction (Speed jump or damaged exciter)

DTC DETECTING CONDITION

DTC No	Detecting Condition	Possible Cause
C1201 (FL) C1204 (FR) C1207 (RL) C1210 (RR)	**Detecting Condition for Speed Jump:** This monitoring is performed for the period that the velocity of each wheel exceeds 1.24mph(2km/h). 1. Controller counts the number of the wheel acceleration of 100 g[15.53mph(25km/h) for 7ms]. When the numbers at one wheel exceed 56 times, or When the numbers at more two wheels exceed 5 times, controller recognize the failure. 2. Controller counts the number of the wheel acceleration of 40g [6.21mph(10km/h) for 7ms]. When the numbers at one wheel exceed 126 times, or when the numbers at more two wheels exceed 20 times, controller recognize the failure. 3. Controller counts the number of the wheel deceleration of -100g[-15.53mph(-25km/h) for 7ms]. When the numbers at each wheel exceed 56 times, controller recognize the failure. 4. The wheel deceleration of -100g[-15.53mph(-25km/h) for 7ms] causes the controller to start monitoring this failure and to comparethe wheel velocity with the vehicle velocity from next cycle. When its difference of -100g is continued for more than 140msec, controller recognize the failure. 5. In case that any sensor failure at other wheel was already detected, When the numbers of 100g at each wheel exceed 5 times, or when the numbers of 40g at each wheel exceed 20 times, controller recognize the failure. **Detecting Condition for Damaged Exciter:** 1. Max. wheel velocity exceeds 12.4mph(20km/h) and the wheel velocity is 40% of max. wheel velocity. If this condition is lasted for 2 minutes. 2. Max. wheel velocity exceeds 24.9mph(40km/h) and the wheel velocity is 60% of max. wheel velocity. If this condition is lasted for 2 minutes.	- Improper installation of wheel speed sensor - An open or short in the wire - Faulty wheel speed sensor - Faulty rotor or wheel bearing - Faulty HECU

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FAILSAFE FUNCTION

Sensor failure outside the ABS control cycle:

1. Only one wheel failure
   Only the ABS(,TCS) function is inhibited. the ABS(,TCS) warning lamp is activated and the EBD warning lamp does not activated.
2. More than two wheels failure
   System down. Both the ABS(,TCS) and the EBD function are inhibited and the ABS(,TCS) and the EBD warning lamps are activated. In this failure, the valve relay and all solenoids are prevented from being switched on.

Sensor failure inside the ABS control cycle:

1. One front wheel failure
   Inhibit the ABS control of the failed-wheel and maintain the ABS control of normal wheel.
   After the controller completes the ABS control, the ABS(,TCS) function is inhibited. The ABS(,TCS) warning lamp is activated and the EBD warning lamp not activated.
2. One rear wheel failure
   Inhibit ABS control of both front wheels and the pressure of both rear wheels is decreased.
   After the controller completes the ABS control, Only the ABS(,TCS) function is inhibited. The ABS(,TCS) warning lamp is activated and the EBD warning lamp not activated.
3. More than two wheels failure.
   System down. Both the ABS(,TCS) and the EBD function are inhibited and the ABS(,TCS) and the EBD warning lamps are activated. In this failure, the valve relay and all solenoids are prevented from being switched on.

INSPECTION PROCEDURES

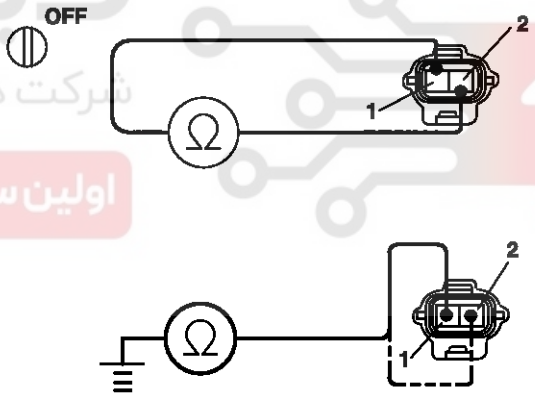
1 . CHECK WHEEL SPEED SENSOR

1. Disconnect the wheel speed sensor connector (2P).
2. Measure the resistance between terminals 1 and 2 of the wheel speed sensor connector.

- **Specification: 1,275~1,495Ω**

3. Measure the resistance between terminals 1 and 2 of the wheel speed sensor connector and body ground.

- **Specification: 1MΩ or higher**



Is the resistance within specification?

Yes	No	Replace the wheel speed sensor.

BJGE522A

2 . CHECK FOR OPEN AND SHORT CIRCUIT

Check for open and short circuit in the harness and connector between each wheel speed sensor and ABS control module.

OK	NG	Repair or replace harness or connector.

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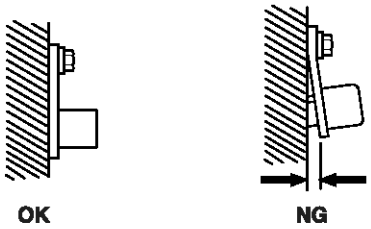
3 . CHECK WHEEL SPEED SENSOR INSTALLATION

Visually check for appropriate wheel speed sensor and rotor installation.

Note)
The mounting bolt shall be tightened properly and there is no clearance is allowed between the sensor and front steering knuckle or rear axle carrier.



OK

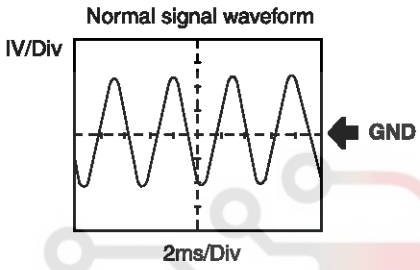
NG	Repair or replace the wheel speed sensor.

BJGE522C

4 . CHECK WHEEL SPEED SENSOR AND SENSOR ROTOR

1. Disconnect the connector from the ABS control module.
2. Rotate the wheel to be measured approximately 1/2 to 1 rotation per second, and check the output voltage and the signal waveform using oscilloscope.

- **Specification: 130mVp-p or more.**



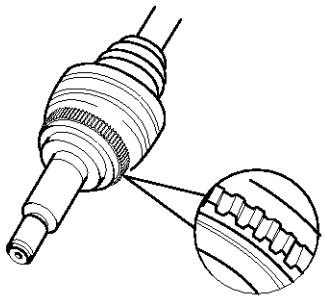
NG

OK	Check and replace the ABS control module.

BJGE522D

5 . CHECK SENSOR ROTOR AND SENSOR TIP

1. Remove the front drive shaft and the rear axle hub.
2. Check the sensor rotor serrations.
   Check if there are no scratches, missing teeth or foreign objects.
3. Remove the front and rear wheel speed sensors.
4. Check if there are no scratches or foreign objects on the sensor tip.



OK

NG	Replace the sensor rotor or wheel speed sensor.

Erase the DTC, and test-drive the vehicle.
If the ABS warning lamp comes on and the same DTC is indicated, replace the ABS control module.

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INSPECTION PROCEDURES FOR DIAGNOSTIC TROUBLE CODES

Wheel Speed Sensor Signal Malfunction

DTC	C1202 (FL) C1205 (FR) C1208 (RL) C1211 (RR)	Wheel Speed Sensor Signal Malfunction (Air-gap error or wrong excite)

DTC DETECTING CONDITION

DTC No	Detecting Condition	Possible Cause
C1202 (FL) C1205 (FR) C1208 (RL) C1211 (RR)	**Detecting Condition for Large Air-Gap:** This monitoring is performed for the period that the minimum velocity rises from 1.24mph(2km/h) to 6.21mph(10km/h). 1. When the minimum wheel velocity is 1.24mph(2km/h) and the velocity of other wheels exceed 6.21mph(10km/h) with the acceleration of < 0.4g, the controller start comparing the velocity of other wheels except the min. wheel. if their differencebelow 2.49mph(4km/h) is continued for 154msec. Otherwise, if their difference beyond 2.49mph(4km/h) or > 0.4g is continued for 2 minutes. 2. In < 0.4g, when the velocity of more two wheels is 1.24mph(2km/h) and the max. wheel velocity exceeds 6.21mph(10km/h), the condition is continued for 20 sec. Otherwise, In >0.4g, the condition is 2 minutes. 3. After velocity of 4 wheel exceeds 6.21mph(10km/h), when velocity of 1 wheel or 2 wheel is 1.24mph(2km/h) and difference of other 2 wheel velocity is less than 4km/h under that those velocity is more than 6.21mph(10km/h), if that conditions are continued for 12 seconds. **Detecting Condition for Long Term ABS mode:** 1. During the ABS control cycle, if the wheel velocity of 1.24mph (2km/h) is lasted for more than 12sec. 2. If the ABS control cycle is continued for more than 36sec.	- Improper installation of wheel speed sensor - An open or short in the wire - Faulty wheel speed sensor - Faulty rotor or wheel bearing - Faulty HECU

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FAILSAFE FUNCTION

Sensor failure outside the ABS control cycle:

1. Only one wheel failure
   Only the ABS(,TCS) function is inhibited. The ABS(,TCS) warning lamp is activated and the EBD warning lamp not activated.
2. More than two wheels failure
   System down. Both the ABS(,TCS) and the EBD function are inhibited and the ABS(,TCS) and the EBD warning lamps are activated. In this failure, the valve relay and all solenoids are prevented from being switched on.

Sensor failure inside the ABS control cycle:

1. One front wheel failure
   Inhibit the ABS control of the failed-wheel and maintain the ABS control of normal wheel.
   After the controller completes the ABS control, the ABS(,TCS) function is inhibited. The ABS(,TCS) warning lamp is activated and the EBD warning lamp not activated.
2. One rear wheel failure
   Inhibit ABS control of both front wheels and the pressure of both rear wheels is decreased.
   After the controller completes the ABS control, Only the ABS(,TCS) function is inhibited. The ABS(,TCS) warning lamp is activated and the EBD warning lamp not activated.
3. More than two wheels failure.
   System down. Both the ABS(,TCS) and the EBD function are inhibited and the ABS(,TCS) and the EBD warning lamps are activated. In this failure, the valve relay and all solenoids are prevented from being switched on.

INSPECTION PROCEDURES

1. CHECK WHEEL SPEED SENSOR INSTALLATION

Visually check for appropriate wheel speed sensor and rotor installation (see table).

DTC	Appropriate wheel sensor
C1202	Front - left wheel sensor
C1205	Front - right wheel sensor
C1208	Rear- left wheel sensor
C1211	Rear- right wheel sensor

Are they installed correctly?

Yes	No	Reinstall or replace the appropriate wheel speed sensor.

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2. CHECK AIR GAP BETWEEN WHEEL SPEED SENSOR AND TONE WHEEL.

- **Specification**
  - Front: 0.2~1.3 mm (0.0079~0.0512 in.)
  - Rear: 0.2~1.3 mm (0.0079~0.0512 in.)

Is the air gap within specification?

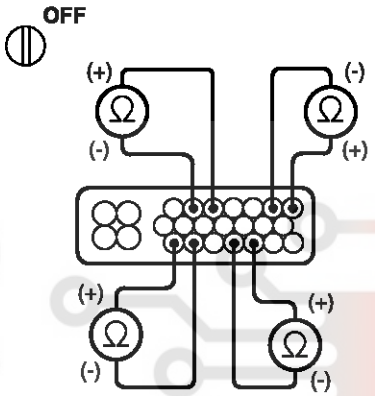
Yes	No	Reinstall or replace the appropriate wheel speed sensor.

BJGE523B

3. CHECK THE RESISTANCE BETWEEN TERMINALS OF HECU.

1. Disconnect the ABS control module connector.
2. Measure the resistance between the appropriate wheel speed sensor(+) and (-) circuit terminals (see table).

DTC	Appropriate Terminal	
	(+) side	(-) side
C1202 (Front - left)	1	2
C1205 (Front - right)	19	20
C1208 (Rear - left)	5	6
C1211 (Rear - right)	23	22



Is the resistance within 1,275~1,495Ω?

Yes	No	Repair an open or short in the wire between the ABS control module and the wheel speed sensor.

Erase the DTC, and test-drive the vehicle.
If the ABS warning lamp comes on and the same DTC is indicated, replace the ABS control module.

BJGE523C

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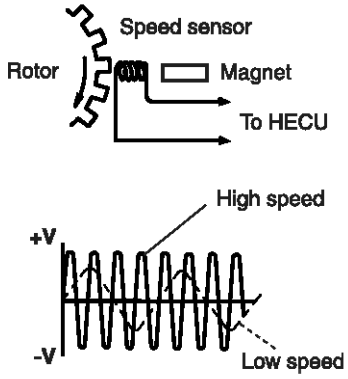
INSPECTION PROCEDURES FOR DIAGNOSTIC TROUBLE CODES

Wheel Speed Sensor Open or Short to Ground

DTC	C1200 (FL) C1203 (FR) C1206 (RL) C1209 (RR)	Wheel Speed Sensor Open or Short to Ground

DESCRIPTION

The wheel speed sensor detects wheel speed and sends the appropriate signals to the HECU. These signals are used to control of the ABS system. The front and rear rotors each have 44 serrations.
When the rotors rotate, the magnetic field emitted by the permanent magnet in the speed sensor generates an AC voltage.
Since the frequency of this AC voltage changes in direct proportion to the speed of the rotor, the frequency is used by HECU to detect the speed of each wheel.



BJGE521A

DTC DETECTING CONDITION

DTC No	Detecting Condition	Possible Cause
C1200 (FL) C1203 (FR) C1206 (RL) C1209 (RR)	The wheel velocity is below 7km/h and the offset voltage of the sensor is outside the permitted range. if this condition is continued for more than 140msec.	- An open or short in the wire - Faulty wheel speed sensor - Faulty HECU

FAILSAFE FUNCTION

Sensor failure outside the ABS control cycle:

1. Only one wheel failure
   Only the ABS(,TCS) function is inhibited. the ABS(,TCS) warning lamp is activated and the EBD warning lamp not activated.
2. More than two wheels failure
   System down. Both the ABS(,TCS) and the EBD function are inhibited and the ABS(,TCS) and the EBD warning lamps is activated. In this failure, the valve relay and all solenoids are prevented from being switched on.

Sensor failure inside the ABS control cycle:

1. One front wheel failure
   Inhibit the ABS control of the failed-wheel and maintain the ABS control of normal wheel.
   After the controller completes the ABS control, the ABS(,TCS) function is inhibited. the ABS(,TCS) warning lamp is activated and the EBD warning lamp not activated.
2. One rear wheel failure
   Inhibit ABS control of both front wheels and the pressure of both rear wheels is decreased.
   After the controller completes the ABS control, only the ABS(,TCS) function is inhibited. the ABS(,TCS) warning lamp is activated and the EBD warning lamp not activated.
3. More than two wheels failure.
   System down. Both the ABS(,TCS) and the EBD function are inhibited and the ABS(,TCS) and the EBD warning lamps is activated. In this failure, the valve relay and all solenoids are prevented from being switched on.

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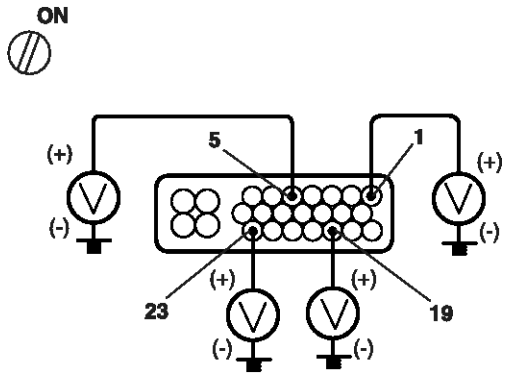
INSPECTION PROCEDURES

1. PROBLEM VERIFICATION

1. Disconnect the ABS control module connector.
2. Start the engine.
3. Measure the voltage between the appropriate wheel sensor(+) circuit terminal and body ground (see table).

DTC	Terminal
C1200 (Front - left)	1
C1203 (Front - right)	19
C1206 (Rear - left)	5
C1209 (Rear - right)	23



Is there 2V or more?

No

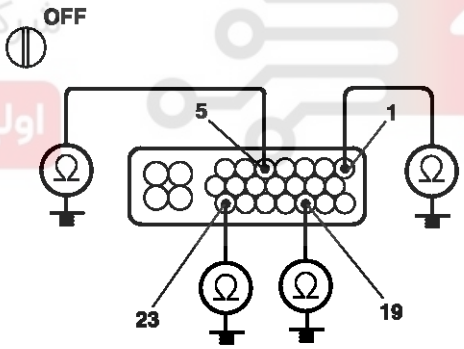
Yes	Repair short to power in the (+) circuit wire between the ABS control module and the appropriate wheel sensor.

BJGE521B

2. CHECK CIRCUIT FOR SHORT TO GROUND.

Check for continuity between the appropriate wheel sensor(+) circuit terminal and body ground (see table).

DTC	Terminal
C1200 (Front - left)	1
C1203 (Front - right)	19
C1206 (Rear - left)	5
C1209 (Rear - right)	23



Is there continuity?

Yes	Disconnect the harness 2P connector from the appropriate wheel sensor, then check for continuity between the (+) and (-) terminals of the harness and body ground. **Is there continuity?**

Yes

No	Replace the wheel sensor.

No

Repair short to body ground in the (+) or (-) circuit wire between the ABS control module and the wheel sensor.

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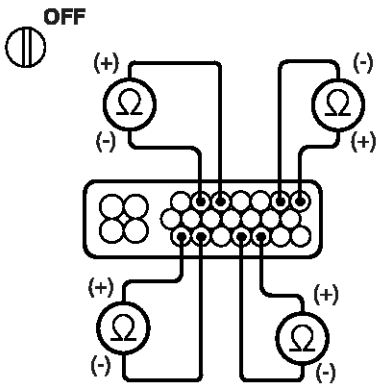
BJGE521C

3. CHECK THE RESISTANCE BETWEEN TERMINALS OF HECU.

Check the resistance between the appropriate wheel sensor (+) and (-) circuit terminals. (see table)

DTC	Terminal	
	(+) side	(-) side
C1200 (Front - left)	1	2
C1203 (Front - right)	19	20
C1206 (Rear - left)	5	6
C1209 (Rear - right)	23	22



Is the resistance within 1,275~1,495Ω?

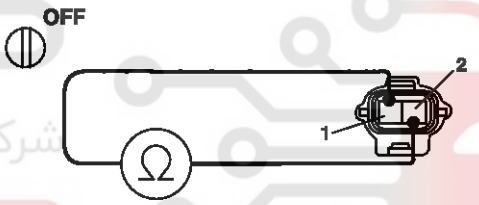
No

Yes	Check for loose ABS control module connectors. If necessary, substitute a known-good ABS control module and recheck.

BJGE521D

4. CHECK THE RESISTANCE BETWEEN TERMINALS OF WHEEL SENSOR

Disconnect the harness 2P connector from the appropriate wheel sensor, and check the resistance between the (+) and (-) terminals of the wheel sensor.



Is the resistance within 1,275~1,495Ω?

Yes

No	Replace the wheel sensor.

BJGE521E

5. REPAIR AN OPEN OR SHORT IN THE WIRE.

Repair open in the (+) or (-) circuit wire, or short between the (+) circuit wire and the (-) circuit wire between the ABS control module and the wheel sensor.

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INSPECTION PROCEDURES FOR DIAGNOSTIC TROUBLE CODES

Wheel Speed Sensor Signal Malfunction

DTC	C1201 (FL) C1204 (FR) C1207 (RL) C1210 (RR)	Wheel Speed Sensor Signal Malfunction (Speed jump or damaged exciter)

DTC DETECTING CONDITION

DTC No	Detecting Condition	Possible Cause
C1201 (FL) C1204 (FR) C1207 (RL) C1210 (RR)	**Detecting Condition for Speed Jump:** This monitoring is performed for the period that the velocity of each wheel exceeds 1.24mph(2km/h). 1. Controller counts the number of the wheel acceleration of 100 g[15.53mph(25km/h) for 7ms]. When the numbers at one wheel exceed 56 times, or When the numbers at more two wheels exceed 5 times, controller recognize the failure. 2. Controller counts the number of the wheel acceleration of 40g [6.21mph(10km/h) for 7ms]. When the numbers at one wheel exceed 126 times, or when the numbers at more two wheels exceed 20 times, controller recognize the failure. 3. Controller counts the number of the wheel deceleration of -100g[-15.53mph(-25km/h) for 7ms]. When the numbers at each wheel exceed 56 times, controller recognize the failure. 4. The wheel deceleration of -100g[-15.53mph(-25km/h) for 7ms] causes the controller to start monitoring this failure and to comparethe wheel velocity with the vehicle velocity from next cycle. When its difference of -100g is continued for more than 140msec, controller recognize the failure. 5. In case that any sensor failure at other wheel was already detected, When the numbers of 100g at each wheel exceed 5 times, or when the numbers of 40g at each wheel exceed 20 times, controller recognize the failure. **Detecting Condition for Damaged Exciter:** 1. Max. wheel velocity exceeds 12.4mph(20km/h) and the wheel velocity is 40% of max. wheel velocity. If this condition is lasted for 2 minutes. 2. Max. wheel velocity exceeds 24.9mph(40km/h) and the wheel velocity is 60% of max. wheel velocity. If this condition is lasted for 2 minutes.	- Improper installation of wheel speed sensor - An open or short in the wire - Faulty wheel speed sensor - Faulty rotor or wheel bearing - Faulty HECU

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FAILSAFE FUNCTION

Sensor failure outside the ABS control cycle:

1. Only one wheel failure
   Only the ABS(,TCS) function is inhibited. the ABS(,TCS) warning lamp is activated and the EBD warning lamp does not activated.
2. More than two wheels failure
   System down. Both the ABS(,TCS) and the EBD function are inhibited and the ABS(,TCS) and the EBD warning lamps are activated. In this failure, the valve relay and all solenoids are prevented from being switched on.

Sensor failure inside the ABS control cycle:

1. One front wheel failure
   Inhibit the ABS control of the failed-wheel and maintain the ABS control of normal wheel.
   After the controller completes the ABS control, the ABS(,TCS) function is inhibited. The ABS(,TCS) warning lamp is activated and the EBD warning lamp not activated.
2. One rear wheel failure
   Inhibit ABS control of both front wheels and the pressure of both rear wheels is decreased.
   After the controller completes the ABS control, Only the ABS(,TCS) function is inhibited. The ABS(,TCS) warning lamp is activated and the EBD warning lamp not activated.
3. More than two wheels failure.
   System down. Both the ABS(,TCS) and the EBD function are inhibited and the ABS(,TCS) and the EBD warning lamps are activated. In this failure, the valve relay and all solenoids are prevented from being switched on.

INSPECTION PROCEDURES

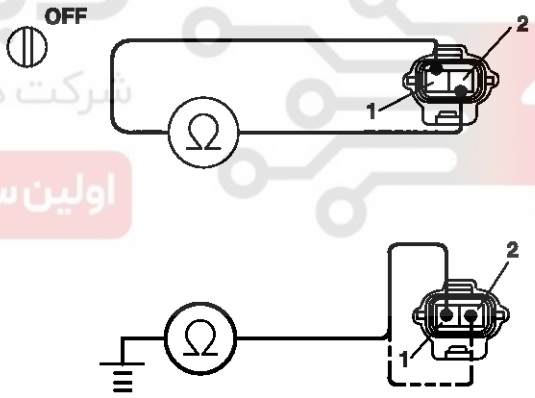
1 . CHECK WHEEL SPEED SENSOR

1. Disconnect the wheel speed sensor connector (2P).
2. Measure the resistance between terminals 1 and 2 of the wheel speed sensor connector.

- **Specification: 1,275~1,495Ω**

3. Measure the resistance between terminals 1 and 2 of the wheel speed sensor connector and body ground.

- **Specification: 1MΩ or higher**



Is the resistance within specification?

Yes	No	Replace the wheel speed sensor.

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2 . CHECK FOR OPEN AND SHORT CIRCUIT

Check for open and short circuit in the harness and connector between each wheel speed sensor and ABS control module.

OK	NG	Repair or replace harness or connector.

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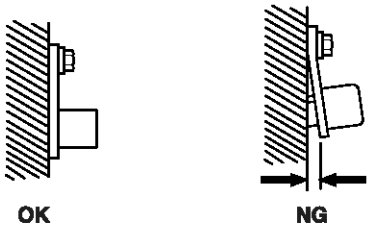
3 . CHECK WHEEL SPEED SENSOR INSTALLATION

Visually check for appropriate wheel speed sensor and rotor installation.

Note)
The mounting bolt shall be tightened properly and there is no clearance is allowed between the sensor and front steering knuckle or rear axle carrier.



OK

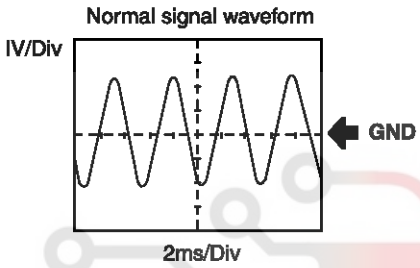
NG	Repair or replace the wheel speed sensor.

BJGE522C

4 . CHECK WHEEL SPEED SENSOR AND SENSOR ROTOR

1. Disconnect the connector from the ABS control module.
2. Rotate the wheel to be measured approximately 1/2 to 1 rotation per second, and check the output voltage and the signal waveform using oscilloscope.

- **Specification: 130mVp-p or more.**



NG

OK	Check and replace the ABS control module.

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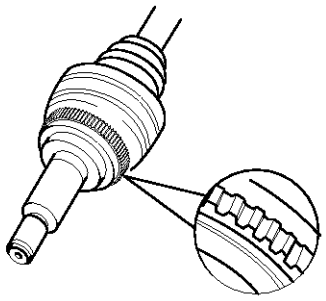
5 . CHECK SENSOR ROTOR AND SENSOR TIP

1. Remove the front drive shaft and the rear axle hub.
2. Check the sensor rotor serrations.
   Check if there are no scratches, missing teeth or foreign objects.
3. Remove the front and rear wheel speed sensors.
4. Check if there are no scratches or foreign objects on the sensor tip.



OK

NG	Replace the sensor rotor or wheel speed sensor.

Erase the DTC, and test-drive the vehicle.
If the ABS warning lamp comes on and the same DTC is indicated, replace the ABS control module.

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INSPECTION PROCEDURES FOR DIAGNOSTIC TROUBLE CODES

Wheel Speed Sensor Signal Malfunction

DTC	**C1202 (FL) C1205 (FR) C1208 (RL) C1211 (RR)**	**Wheel Speed Sensor Signal Malfunction (Air-gap error or wrong excite)**

DTC DETECTING CONDITION

DTC No	Detecting Condition	Possible Cause
C1202 (FL) C1205 (FR) C1208 (RL) C1211 (RR)	**Detecting Condition for Large Air-Gap:** This monitoring is performed for the period that the minimum velocity rises from 1.24mph(2km/h) to 6.21mph(10km/h). 1. When the minimum wheel velocity is 1.24mph(2km/h) and the velocity of other wheels exceed 6.21mph(10km/h) with the acceleration of < 0.4g, the controller start comparing the velocity of other wheels except the min. wheel. if their differencebelow 2.49mph(4km/h) is continued for 154msec. Otherwise, if their difference beyond 2.49mph(4km/h) or > 0.4g is continued for 2 minutes. 2. In < 0.4g, when the velocity of more two wheels is 1.24mph(2km/h) and the max. wheel velocity exceeds 6.21mph(10km/h), the condition is continued for 20 sec. Otherwise, In >0.4g, the condition is 2 minutes. 3. After velocity of 4 wheel exceeds 6.21mph(10km/h), when velocity of 1 wheel or 2 wheel is 1.24mph(2km/h) and difference of other 2 wheel velocity is less than 4km/h under that those velocity is more than 6.21mph(10km/h), if that conditions are continued for 12 seconds. **Detecting Condition for Long Term ABS mode:** 1. During the ABS control cycle, if the wheel velocity of 1.24mph (2km/h) is lasted for more than 12sec. 2. If the ABS control cycle is continued for more than 36sec.	- Improper installation of wheel speed sensor - An open or short in the wire - Faulty wheel speed sensor - Faulty rotor or wheel bearing - Faulty HECU

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FAILSAFE FUNCTION

Sensor failure outside the ABS control cycle:

1. Only one wheel failure
   Only the ABS(,TCS) function is inhibited. The ABS(,TCS) warning lamp is activated and the EBD warning lamp not activated.
2. More than two wheels failure
   System down. Both the ABS(,TCS) and the EBD function are inhibited and the ABS(,TCS) and the EBD warning lamps are activated. In this failure, the valve relay and all solenoids are prevented from being switched on.

Sensor failure inside the ABS control cycle:

1. One front wheel failure
   Inhibit the ABS control of the failed-wheel and maintain the ABS control of normal wheel.
   After the controller completes the ABS control, the ABS(,TCS) function is inhibited. The ABS(,TCS) warning lamp is activated and the EBD warning lamp not activated.
2. One rear wheel failure
   Inhibit ABS control of both front wheels and the pressure of both rear wheels is decreased.
   After the controller completes the ABS control, Only the ABS(,TCS) function is inhibited. The ABS(,TCS) warning lamp is activated and the EBD warning lamp not activated.
3. More than two wheels failure.
   System down. Both the ABS(,TCS) and the EBD function are inhibited and the ABS(,TCS) and the EBD warning lamps are activated. In this failure, the valve relay and all solenoids are prevented from being switched on.

INSPECTION PROCEDURES

1. CHECK WHEEL SPEED SENSOR INSTALLATION

Visually check for appropriate wheel speed sensor and rotor installation (see table).

DTC	Appropriate wheel sensor
C1202	Front - left wheel sensor
C1205	Front - right wheel sensor
C1208	Rear- left wheel sensor
C1211	Rear- right wheel sensor

Are they installed correctly?

Yes	No	Reinstall or replace the appropriate wheel speed sensor.

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2. CHECK AIR GAP BETWEEN WHEEL SPEED SENSOR AND TONE WHEEL.

- **Specification**
  - Front: 0.2~1.3 mm (0.0079~0.0512 in.)
  - Rear: 0.2~1.3 mm (0.0079~0.0512 in.)

Is the air gap within specification?

Yes	No	Reinstall or replace the appropriate wheel speed sensor.

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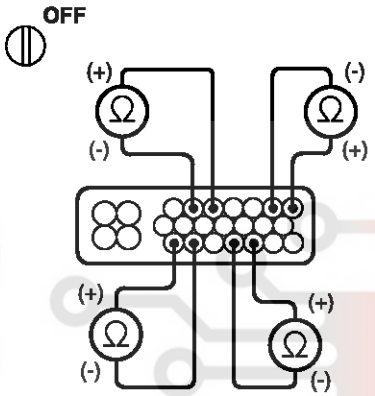
3. CHECK THE RESISTANCE BETWEEN TERMINALS OF HECU.

1. Disconnect the ABS control module connector.
2. Measure the resistance between the appropriate wheel speed sensor(+) and (-) circuit terminals (see table).

DTC	Appropriate Terminal	
	(+) side	(-) side
C1202 (Front - left)	1	2
C1205 (Front - right)	19	20
C1208 (Rear - left)	5	6
C1211 (Rear - right)	23	22



Is the resistance within 1,275~1,495Ω?

Yes	No	Repair an open or short in the wire between the ABS control module and the wheel speed sensor.

Erase the DTC, and test-drive the vehicle.
If the ABS warning lamp comes on and the same DTC is indicated, replace the ABS control module.

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INSPECTION PROCEDURES FOR DIAGNOSTIC TROUBLE CODES

TCS Switch Failure

DTC	C1503	TCS Switch Failure (only System with TCS)

DESCRIPTION

When the TCS switch is pressed, TCS control is deactivated and the TCS OFF indicator lights up.
The TCS OFF indicator turns "ON" when the HECU prohibits TCS controls.

DTC DETECTING CONDITION

DTC No	Detecting Condition	Possible Cause
C1503	The condition that the level of TCS switch is high, which is continued for 60 sec.	- An open or short in the TCS switch circuit - Faulty TCS switch - Faulty HECU

FAILSAFE FUNCTION

Inhibit the TCS control and allow the ABS/EBD control.
Meanwhile, stop checking the TCS switch failure under the TCS control.

INSPECTION PROCEDURES

1. CHECK THE DTC ONCE MORE.

1. Clear the DTC using hi-scan (pro).
2. Turn the ignition switch OFF.
3. Turn the ignition switch ON, and check if the same DTC is stored in the memory.

Yes	No	Problem is intermittent and the ABS control module memory was not cleared.

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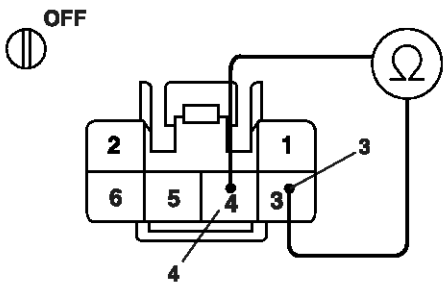
2. CHECK THE TCS SWITCH.

1. Remove the TCS switch.
2. Check for continuity between the terminals while operating the TCS switch.

Is there continuity between terminals 3 and 4 of TCS switch side connector with TCS switch ON?



Yes	No	Replace the TCS switch with new one and recheck.

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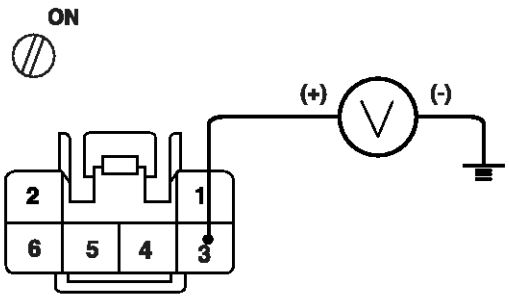
3. CHECK THE POWER SUPPLY CIRCUIT.

1. Disconnect the connector from the TCS switch.
2. Turn the ignition switch ON.
3. Measure the power supply voltage between terminal 3 of TCS switch harness side connector and body ground.

- **Specification: approximately B+**

Is the voltage within specification?



Yes	
No	Check and replace fuse (10A). Check and repair harness or connector.

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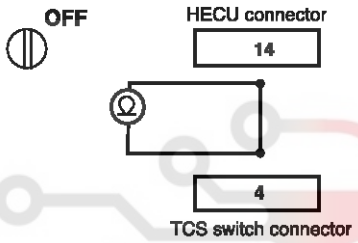
4. CHECK FOR OPEN IN THE WIRE.

Check for continuity in the wire between terminal 4 of TCS switch harness side connector and terminal 14 of HECU harness side connector.

Is there continuity?



Yes	
No	Check and repair harness or connector.

Erase the DTC, and test-drive the vehicle.
If the same DTC is indicated, replace the ABS control module.

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INSPECTION PROCEDURES FOR DIAGNOSTIC TROUBLE CODES

ECU Hardware Failure

DTC	C1604 C2380	ECU Hardware Failure (ECU Internal or Solenoid Valve Failure)

DESCRIPTION

The HECU always monitors the solenoid valve drive circuit.
It determines that there is an open or short-circuit in the solenoid coil or in a harness even if no current flows in the solenoid or through the HECU.

DTC DETECTING CONDITION

DTC No	Detecting Condition	Possible Cause
C1604	**Detecting Condition for EEPROM Failure of ECU:** When the MCU can't erase or write a data of the EEPROM. **Detecting Condition for MCU Failure of ECU:** If the master/slave processor detects abnormal operation in RAM , status register, interrupt, timer, A/D converter and cycle time.	- ECU circuit failure
C2380	**Detecting Condition for Solenoid Valve Open or Short:** 1. When the valve relay is switched off, the drain voltage of the solenoid drive MOSFET is over the criterion, which is continued for 56msec. 2. When the valve relay is switched on and a solenoid off, the drain voltage of the solenoid drive MOSFET is under the criterion, which is continued for 56msec. 3. When the valve relay and a solenoid are switched on, the drain voltage of the solenoid drive MOSFET is over the criterion, which is continued for 56msec.	- An open or short in the solenoid valve circuit - Leakage current in the solenoid valve - Faulty HECU

FAILSAFE FUNCTION

System down. Both the ABS(,TCS) and the EBD function are inhibited and the ABS(,TCS) and the EBD warning lamps are activated. In this failure, the valve relay and all solenoids are prevented from being switched on.

INSPECTION PROCEDURES

1 . CHECK THE DTC ONCE MORE

1. Clear the DTC using the Hi-scan (Pro).
2. Turn the ignition switch OFF.
3. Turn the ignition switch ON, and check if the same DTC is stored in the memory.

Yes	No	Problem is intermittent and the ABS control module memory was not cleared.

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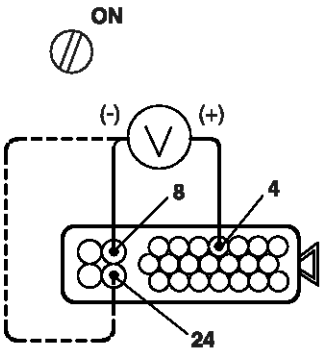
2 . CHECK VOLTAGE BETWEEN TERMINALS OF HECU CONNECTOR

1. Disconnect the connector from the ABS control module.
2. Turn the ignition switch ON.
3. Measure the voltage between terminals 4 and 8, 24 of ABS control module harness side connector.

- **Specification: approximately B+**

4. Measure the resistance between terminals 8 or 24 of ABS control module harness side connector and (-) circuit terminal of battery.

- **Specification: approximately below 1Ω**



Is the voltage within specification?

Yes	No	Check for open or short in the wire.

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3 . CHECK CONNECTION OF HECU

Check the connection of ABS control module connector

OK	NG	Repair or replace harness or connector.

Check and replace the ABS control module.

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INSPECTION PROCEDURES FOR DIAGNOSTIC TROUBLE CODES

CAN Hardware Failure

DTC	C1605	CAN Hardware Failure (only System with TCS)

DESCRIPTION

The CAN circuit is used to send TCS control information from the HECU to the engine ECM and TCM, and engine and transmission control information from the engine ECM and TCM to the HECU.

DTC DETECTING CONDITION

DTC No	Detecting Condition	Possible Cause
C1605	In case that CAN has hardware failure.	- Faulty CAN or bus

FAILSAFE FUNCTION

Inhibit the TCS control and allow the ABS/EBD control.

INSPECTION PROCEDURES FOR DIAGNOSTIC TROUBLE CODES

CAN Bus Off Failure

DTC	C1610	CAN Bus Off Failure (only System with TCS)

DESCRIPTION

The CAN circuit is used to send TCS control information from the HECU to the engine ECM and TCM, and engine and transmission control information from the engine ECM and TCM to the HECU.

DTC DETECTING CONDITION

DTC No	Detecting Condition	Possible Cause
C1610	In case CAN BUS off state continued for more than 0.1sec.	- An open or short in the CAN bus circuit - Faulty CAN bus - Faulty HECU

FAILSAFE FUNCTION

Inhibit the TCS control and allow the ABS/EBD control.

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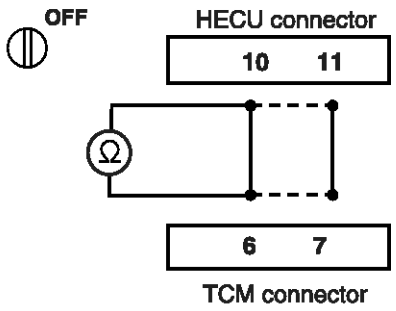
INSPECTION PROCEDURES

1. CHECK FOR OPEN IN THE CAN LINE.

1. Check for continuity in the wire between terminal 10 of HECU harness side connector and terminal 6 of TCM harness side connector.
2. Check for continuity in the wire between terminal 11 of HECU harness side connector and terminal 7 of TCM harness side connector.

Is there continuity?



Yes	No	Check and repair harness or connector.

Check the TCM according to the instructions of engine or T/M group.

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INSPECTION PROCEDURES FOR DIAGNOSTIC TROUBLE CODES

EMS Time-out Failure

DTC	C1611	EMS Time-out Failure (only System with TCS)

DESCRIPTION

HECU will compare signals from front (driving) and rear wheel speed sensors to detect driving wheels slip.
Upon detecting driving wheels slip, HECU will perform TCS control.
The HECU will transmit engine torque reduction request, fuel cut cylinder number, and TCS control request signals in accordance with slip level to engine ECM and TCM through BUS line which will provide CAN communication for TCS control.
Engine ECM will perform fuel cut as requested by HECU and retard ignition timing as per engine torque reduction request signal.
TCM will hold shift position by TCS control time according to TCS operation signal.
Then enhanced acceleration by kick-down will not occur.

DTC DETECTING CONDITION

DTC No	Detecting Condition	Possible Cause
C1611	1. In case that EMS1 or EMS2 message was not received for more than 0.5 sec. within normal voltage condition. 2. The monitoring starts 2 sec. after power up.	- An open or short in the CAN bus circuit - Faulty CAN bus - Faulty EMS - Faulty HECU

FAILSAFE FUNCTION

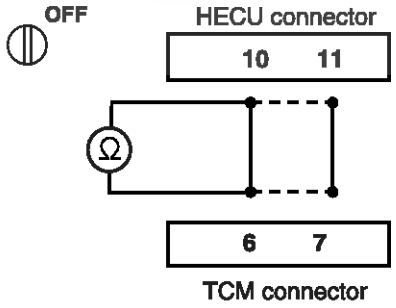
Inhibit the TCS control and allow the ABS/EBD control.

INSPECTION PROCEDURES

1. CHECK FOR OPEN IN THE CAN LINE.

1. Check for continuity in the wire between terminal 10 of HECU harness side connector and terminal 6 of TCM harness side connector.
2. Check for continuity in the wire between terminal 11 of HECU harness side connector and terminal 7 of TCM harness side connector.

Is there continuity?



Yes

No	Check and repair harness or connector.

Check the TCM according to the instructions of engine or T/M group.

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INSPECTION PROCEDURES FOR DIAGNOSTIC TROUBLE CODES

TCM Time-out Failure

DTC	C1612	TCM Time-out Failure (only System with TCS)

DESCRIPTION

HECU will compare signals from front (driving) and rear wheel speed sensors to detect driving wheels slip.
Upon detecting driving wheels slip, HECU will perform TCS control.
The HECU will transmit engine torque reduction request, fuel cut cylinder number, and TCS control request signals in accordance with slip level to engine ECM and TCM through BUS line which will provide CAN communication for TCS control.
Engine ECM will perform fuel cut as requested by HECU and retard ignition timing as per engine torque reduction request signal.
TCM will hold shift position by TCS control time according to TCS operation signal.
Then enhanced acceleration by kick-down will not occur.

DTC DETECTING CONDITION

DTC No	Detecting Condition	Possible Cause
C1612	1. In case that TCM message was not received for more than 0.5 sec. within normal voltage condition. 2. The monitoring starts 2 sec. after power up.	- An open or short in the CAN bus circuit - Faulty CAN bus - Faulty TCM - Faulty HECU

FAILSAFE FUNCTION

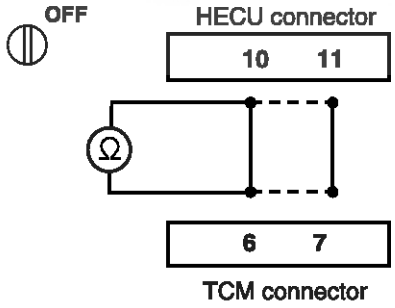
Inhibit the TCS control and allow the ABS/EBD control.

INSPECTION PROCEDURES

1. CHECK FOR OPEN IN THE CAN LINE.

1. Check for continuity in the wire between terminal 10 of HECU harness side connector and terminal 6 of TCM harness side connector.
2. Check for continuity in the wire between terminal 11 of HECU harness side connector and terminal 7 of TCM harness side connector.

Is there continuity?



Yes

No	Check and repair harness or connector.

Check the TCM according to the instructions of engine or T/M group.

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INSPECTION PROCEDURES FOR DIAGNOSTIC TROUBLE CODES

TCM Wrong-Matched Transmission Failure

DTC	C1613	TCM Wrong-Matched Transmission Failure (only System with TCS)

DESCRIPTION

HECU will compare signals from front (driving) and rear wheel speed sensors to detect driving wheels slip.
Upon detecting driving wheels slip, HECU will perform TCS control.
The HECU will transmit engine torque reduction request, fuel cut cylinder number, and TCS control request signals in accordance with slip level to engine ECM and TCM through BUS line which will provide CAN communication for TCS control.
Engine ECM will perform fuel cut as requested by HECU and retard ignition timing as per engine torque reduction request signal.
TCM will hold shift position by TCS control time according to TCS operation signal.
Then enhanced acceleration by kick-down will not occur.

DTC DETECTING CONDITION

DTC No	Detecting Condition	Possible Cause
C1613	1. In case that the information about transmission is different in the EMS message and TCM message within normal voltage condition. 2. The monitoring starts 2 sec. after power up.	- Faulty CAN bus - Faulty EMS or TCM

FAILSAFE FUNCTION

Inhibit the TCS control and allow the ABS/EBD control.

INSPECTION PROCEDURES FOR DIAGNOSTIC TROUBLE CODES

Valve Relay Failure

DTC	C2112	Valve Relay Failure (Valve Relay or Fuse Failure)

DESCRIPTION

When the ignition switch is turned ON, the HECU switches the valve relay on and off during its initial check. During this time, voltage sent to the valve relay is compared to the voltage in the valve power monitor line. If no current is detected in the valve power monitor line, the HECU determines that there is an open circuit and DTC C2112 is recorded.

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DTC DETECTING CONDITION

DTC No	Detecting Condition	Possible Cause
C2112	**Detecting Condition for Valve Relay Open:** When the valve relay is switched on, the reference voltage of valve relay is under the permitted range, which is continued for 56 msec. **Detecting Condition for Valve Relay Short:** When the valve relay is switched off, the reference voltage of valve relay is over the permitted range, which is continued for 56msec.	- An open or short in the valve relay circuit - Faulty HECU

FAILSAFE FUNCTION

System down. Both the ABS(,TCS) and the EBD function are inhibited and the ABS(,TCS) and the EBD warning lamps are activated. In this failure, the valve relay and all solenoids are prevented from being switched on.

INSPECTION PROCEDURES

1 . CHECK THE DTC ONCE MORE

1. Clear the DTC using the Hi-scan (Pro).
2. Turn the ignition switch OFF.
3. Turn the ignition switch ON, and check if the same DTC is stored in the memory.

Yes	No	Problem is intermittent and the ABS control module memory was not cleared.

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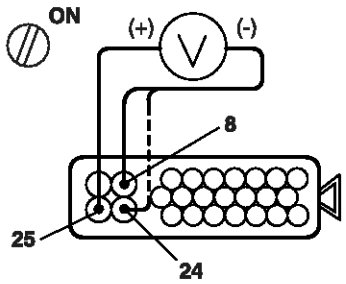
2 . CHECK THE POWER SOURCE OF VALVE RELAY

1. Disconnect the connector from the ABS control module.
2. Measure the voltage between the terminals 25 and 8, 24 of the ABS control module harness side connector.

- **Specification: approximately B+**

Is the voltage within specification?



Yes	NO	Check and replace fuse (10A) and fusible link (30A). Check and repair harness or connector.

If the same code is still output after the DTC is deleted, check the contact condition of each connection.
If the connections are normal, the ABS control module may be defective.

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INSPECTION PROCEDURES FOR DIAGNOSTIC TROUBLE CODES

Brake Disc Overheat

DTC	C2227	Brake Disc Overheat (only System with TCS)

DESCRIPTION

On TCS control, brake control will be performed by motor pump output pressure.
This brake traction control cause the brake disc to overheat.

DTC DETECTING CONDITION

DTC No	Detecting Condition	Possible Cause
C2227	1. When the calculated temperature of disc is higher than predefined value. 2. If the calculated temperature reach to predefined value, the controller recovers to normal state.	- Brake disc is overheating

FAILSAFE FUNCTION

Inhibit the TCS control and allow the ABS/EBD control.

INSPECTION PROCEDURES FOR DIAGNOSTIC TROUBLE CODES

ECU Hardware Failure

DTC	C1604 C2380	ECU Hardware Failure (ECU Internal or Solenoid Valve Failure)

DESCRIPTION

The HECU always monitors the solenoid valve drive circuit.
It determines that there is an open or short-circuit in the solenoid coil or in a harness even if no current flows in the solenoid or through the HECU.

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DTC DETECTING CONDITION

DTC No	Detecting Condition	Possible Cause
C1604	**Detecting Condition for EEPROM Failure of ECU:** When the MCU can't erase or write a data of the EEPROM. **Detecting Condition for MCU Failure of ECU:** If the master/slave processor detects abnormal operation in RAM , status register, interrupt, timer, A/D converter and cycle time.	- ECU circuit failure
C2380	**Detecting Condition for Solenoid Valve Open or Short:** 1. When the valve relay is switched off, the drain voltage of the solenoid drive MOSFET is over the criterion, which is continued for 56msec. 2. When the valve relay is switched on and a solenoid off, the drain voltage of the solenoid drive MOSFET is under the criterion, which is continued for 56msec. 3. When the valve relay and a solenoid are switched on, the drain voltage of the solenoid drive MOSFET is over the criterion, which is continued for 56msec.	- An open or short in the solenoid valve circuit - Leakage current in the solenoid valve - Faulty HECU

FAILSAFE FUNCTION

System down. Both the ABS(,TCS) and the EBD function are inhibited and the ABS(,TCS) and the EBD warning lamps are activated. In this failure, the valve relay and all solenoids are prevented from being switched on.

INSPECTION PROCEDURES

1 . CHECK THE DTC ONCE MORE

1. Clear the DTC using the Hi-scan (Pro).
2. Turn the ignition switch OFF.
3. Turn the ignition switch ON, and check if the same DTC is stored in the memory.

Yes

No	Problem is intermittent and the ABS control module memory was not cleared.

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2 . CHECK VOLTAGE BETWEEN TERMINALS OF HECU CONNECTOR

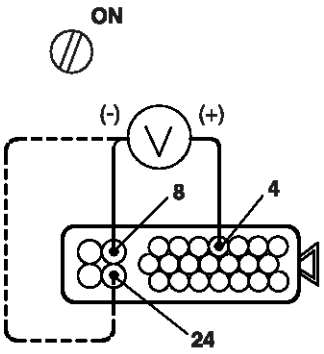
1. Disconnect the connector from the ABS control module.
2. Turn the ignition switch ON.
3. Measure the voltage between terminals 4 and 8, 24 of ABS control module harness side connector.

- **Specification: approximately B+**

4. Measure the resistance between terminals 8 or 24 of ABS control module harness side connector and (-) circuit terminal of battery.

- **Specification: approximately below 1Ω**

Is the voltage within specification?



Yes		
	No	Check for open or short in the wire.

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3 . CHECK CONNECTION OF HECU

Check the connection of ABS control module connector

OK		
	NG	Repair or replace harness or connector.

Check and replace the ABS control module.

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INSPECTION PROCEDURES FOR DIAGNOSTIC TROUBLE CODES

Motor Relay

DTC	C2402	Motor Relay or Motor Electrical Failure

DESCRIPTION

The ABS motor relay supplies power to the ABS pump motor.
While the ABS is activated, the HECU switches the ABS motor relay ON and operates the ABS pump motor.

DTC DETECTING CONDITION

DTC No	Detecting Condition	Possible Cause
C2402	**Detecting Condition for Motor Relay Open or Motor Short to Battery:** When the motor relay is switched on, the reference voltage of motor is over the criterion, which is continued for 49msec. **Detecting Condition for Motor Lock:** The controller starts monitoring the motor voltage for 84msec from the time when the motor relay is switched off. If themotor voltage is over the criterion for 49msec after shutting off the motor, the motor is reactivated for 500msec aftershutting off the motor 84 msec and the above check is performed again for a maximum of two times. When the motor voltageis not normal even on the second check, the controller recognizes it as failure. **Detecting Condition for Fuse Open, Motor Open or Short to Ground:** The controller starts monitoring the motor after 1.8sec from the time when the motor relay is switched off. If the motor voltage is under the criterion for 0.2 sec.	- An open or short in the motor relay or motor circuit - Motor lock - Faulty HECU

FAILSAFE FUNCTION

1. Only the ABS(,TCS) function is inhibited. The ABS(,TCS) warning lamp is activated and the EBD warning lamp not activated.
2. Motor error during the ABS control cycle : Inhibit the ABS control of front wheels, allow ABS control of the rear wheels, and ABS(,TCS) warning lamp is switched ON at the end of ABS control.

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INSPECTION PROCEDURES

1. TEST MOTOR ACTUATION USING HI-SCAN (PRO).

Is the operating sound of motor heard?

No

Yes	Check the harness and repair if necessary.

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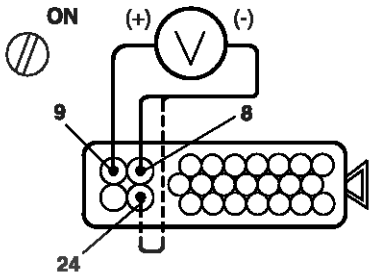
2. CHECK THE POWER SOURCE OF MOTOR.

1. Disconnect the connector from the ABS control module.
2. Measure the voltage between the terminals 9 and 8, 24 of the ABS control module harness side connector.

- **Specification: approximately B+**

Is the voltage within specification?



Yes

No	Check and replace fuses. Check and repair harness or connector.

If the same code is still output after the DTC is deleted, check the contact condition of each connection.
If the connections are normal, the ABS control module may be defective.

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